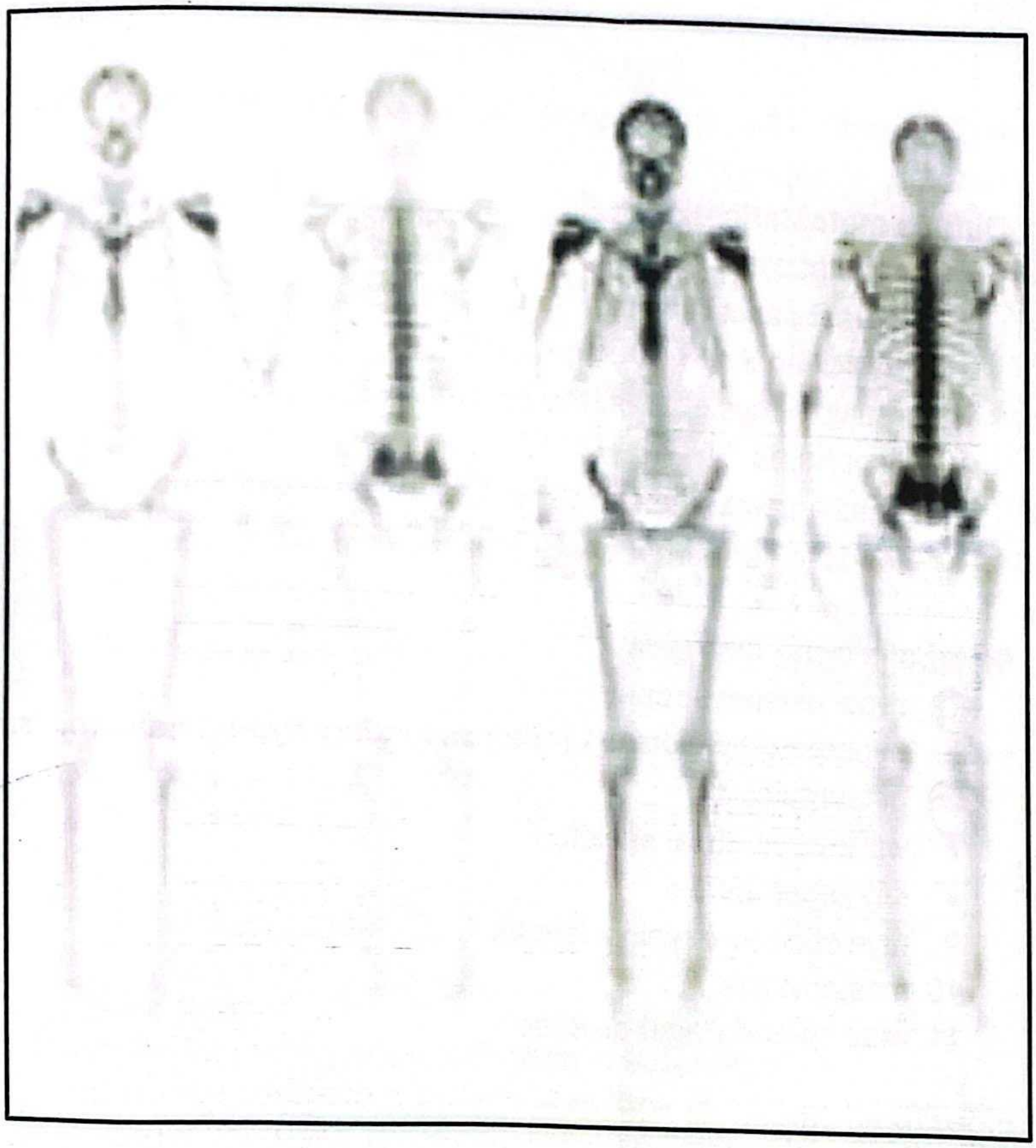
MISCELLANEOUS

Q.1) **(2017)**



Identify: Superscan

Pick Point: Renal uptake not seen (seen in bone scan)

Definition: Superscan is intense symmetric activity in the bones with diminished renal and soft tissue activity on a Tc99m diphosphonate bone scan.

Describe: All Radiotracer is concentrated in the skeleton with little or no activity in soft tissues or urinary tract giving excellent bone detail.

Tc-99m MDP uptake depends on osteoblast and osteoclast activity.

- Increased uptake-osteoblastic activity present
- Decreased uptake-pure lytic lesion osteoclast activity

Tecnique:

1. Patients should be well hydrated

2. The patient should be asked to urinate immediately before delayed imaging
3. Drink plenty of fluids for at least 24h after radiopharmaceutical administration

Indications: This appearance can result from a range of aetiological factors:

Diffuse metastatic disease

1. prostatic carcinoma
2. breast cancer
3. transitional cell carcinoma (TCC)
4. multiple myeloma (some difference in opinion)
5. lymphoma

- patchy uptake nonetheless: look at skull and ribs
- tends to somewhat spare the distal skeleton

Metabolic bone diseases

6. renal osteodystrophy
7. hyperparathyroidism 1 (often secondary hyperparathyroidism)
8. osteomalacia

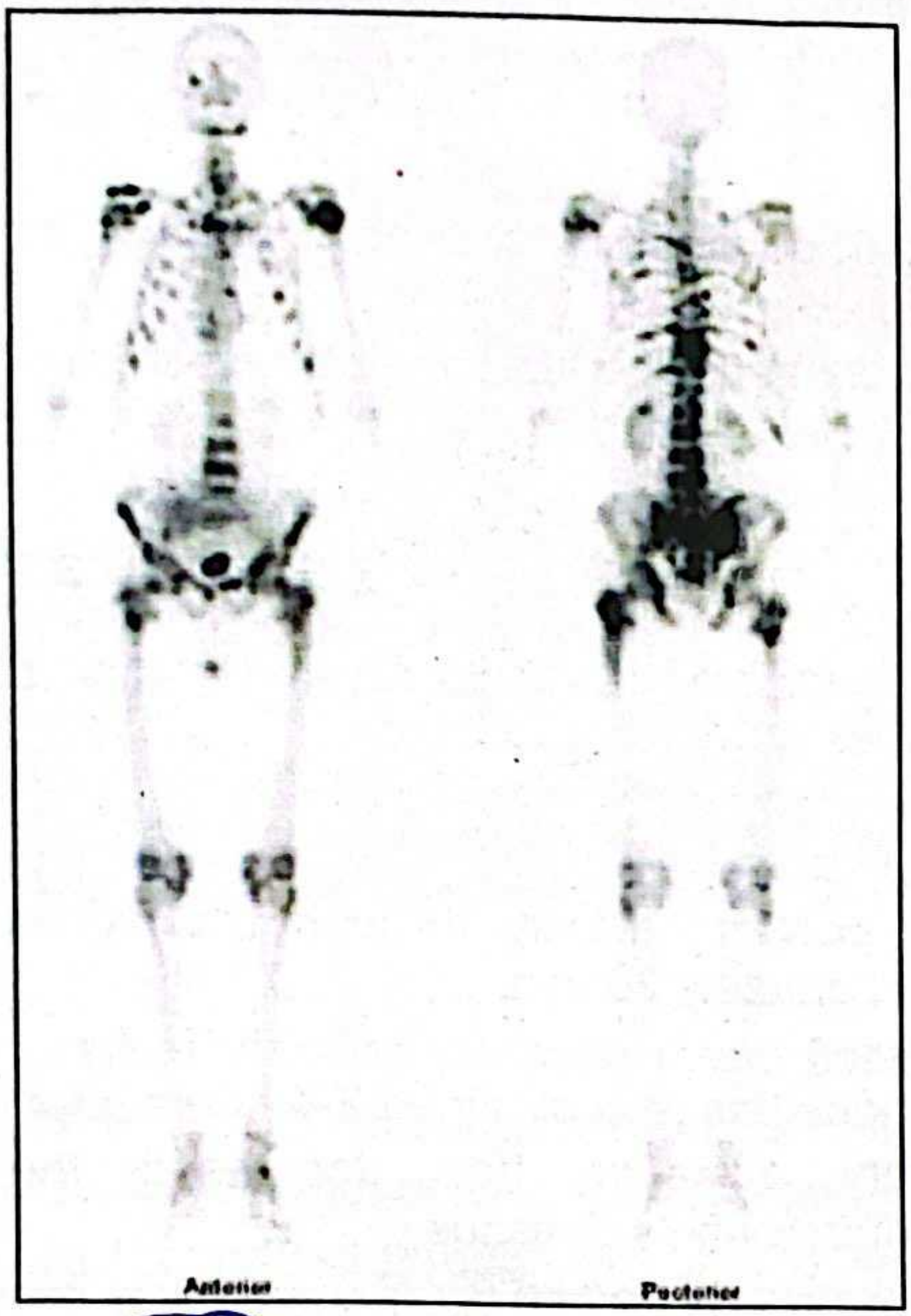
- will involve distal skeleton
- smoother uptake

9. myelofibrosis/myelosclerosis
10. mastocytosis
11. wide spread Paget disease

Contraindications:

1. Patient recently had contrast media fo a different study.
2. Patient Recently (24-48 hrs) had a TC99m-based nuclear scan
3. Pregnancy
4. Breast feeding after scan

Q.2) Indentify **(2018)**



Identify: Bone Scan 26 hrs.
Pick Point: Renal uptake seen (not seen in super scan)
Definition: Bone scans are a nuclear medicine (scintigraphy) that makes use of Technetium 99m (commonly Tc99m-methylene diphosphonate (MDP)) as the active agent.
Technique:

1. Patients should be well hydrated
2. The patient should be asked to urinate immediately before delayed imaging
3. Tc99m diphosphonate is administered intravenously, at a dose of 20 mCi.
4. Drink plenty of fluids for at least 24h after radiopharmaceutical administration
5. The biological half-life of phosphonates is 26 h.
6. In a normal bone scan all but the smallest bones are recognizable.
7. On the anterior view it is possible to distinguish the sternum.
8. On the posterior view the bodies of individual vertebrae are seen, as well as pedicles and transverse and spinous processes in the

lower dorsal and lumbar regions. In this projection the sacro-iliac joints usually have the highest uptake.

9. Skull can appear un even
10. Kidneys routinely visualized
11. In children the appearance of the bone scan is characterized by areas of uptake due to active growth in the epiphyseal regions.

Phases

Flow phase

- 2-to-5 second images are obtained for 60 seconds after injection
- demonstrates perfusion and characterises the blood flow to a particular area

Blood pool phase

- the blood-pool image is obtained 5 minutes after injection
- demonstrates the blood pool, not the blood flow
- inflammation causes capillary dilatation and increased blood flow
- If the study is going to be a triphasic bone scan, a third phase is added.
- The peak of activity through the kidneys is reached after approximately 20 min.

Delayed phase

- the bone image is obtained 2-4 hours later
- urinary excretion has decreased the amount of the radionuclide in soft tissue
- mechanism of uptake is not uncertainly known
- degree of uptake depends on blood flow and rate of new bone formation

Delayed/delayed

- obtained 24 hours after injection as a static image

Indications:

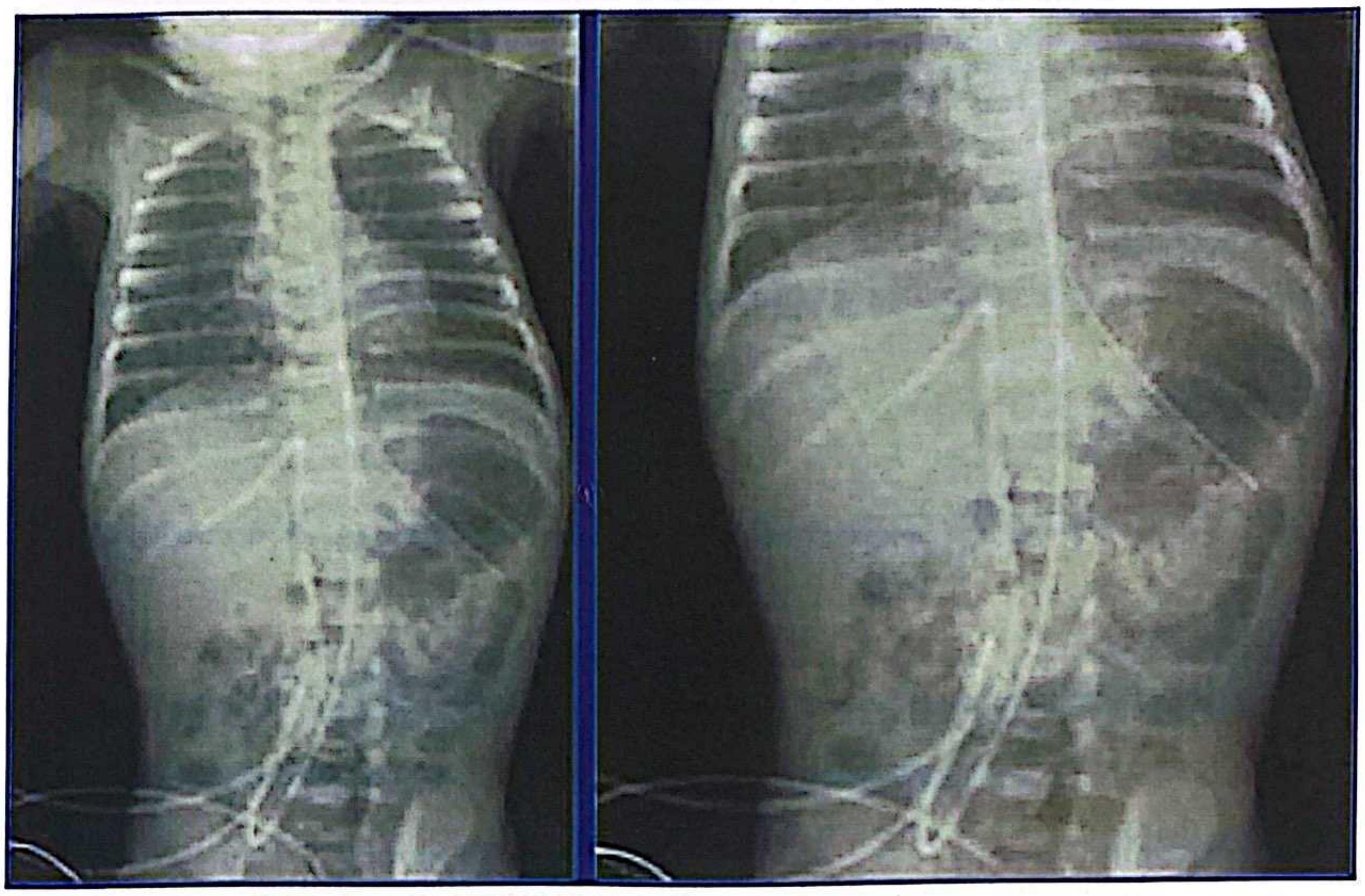
1. Malignancy: detection and follow-up of skeletal metastases
2. Detection of radiographically occult fractures, e.g. stress or insufficiency fractures
3. osteomyelitis
4. Reflex sympathetic dystrophy
5. Hip joint prosthesis: evaluation for infection or loosening
6. Paget's disease

Contraindications:

1. Patient recently had contrast media fo a different study.
2. Patient Recently (24-48 hrs) had a TC99m-based nuclear scan
3. Pregnancy
4. Breast feeding after scan

ebook.pk

Q.3) **(2018)**



Umbilical artery catheterization provides direct access to the arterial system and allows accurate measurement of arterial blood pressure, blood sampling and intravascular access for fluids and medications.

The catheter should be passed through the umbilic artery and enter the aorta via the internal iliac artery.

It should demonstrate the typical loop from the umbilicus inferiorly into the internal iliac artery.

In order to avoid placement into aortic branches, the catheter should be either in a high position above the celiac, mesenteric and renal arteries or in a low position below the inferior mesenteric artery:

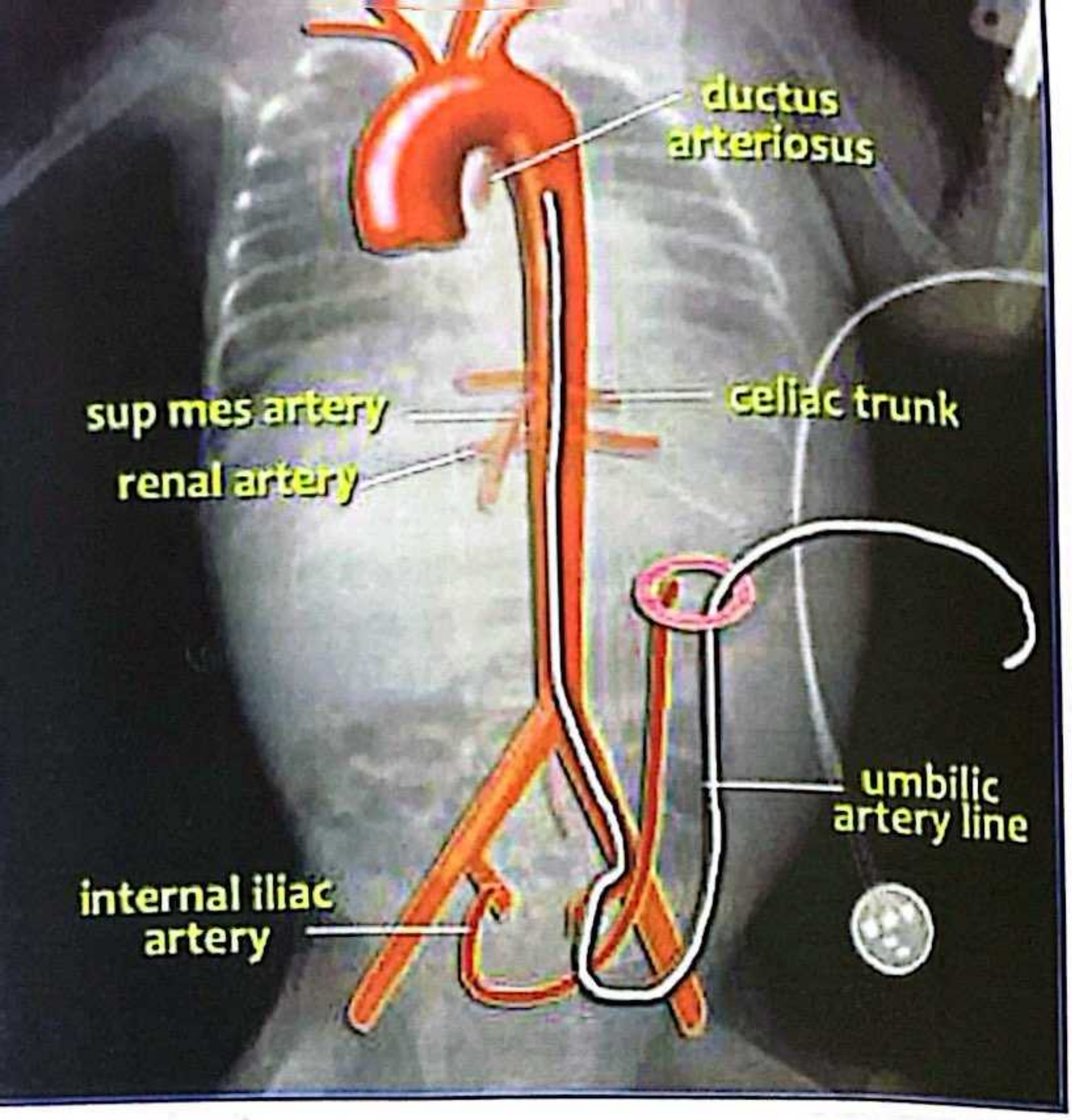
High position: T6-T9

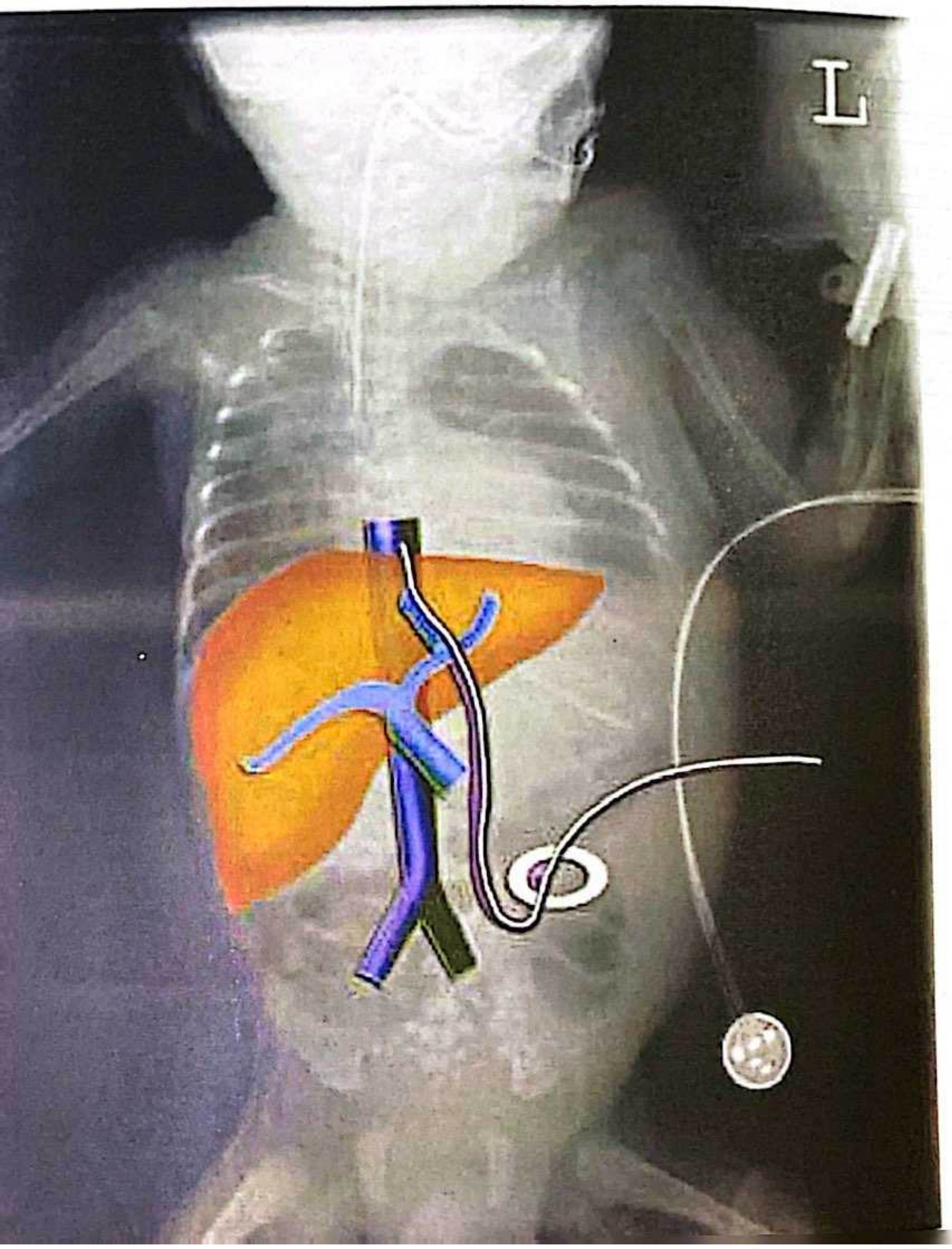
Low position: L3-L5

Umbilical vein catheter should pass through the umbilic vein into the left portal vein.

Then through the ductus venosus into a hepatic vein and the inferior caval vein (IVC).

The tip should be positioned in the IVC at the level of the diaphragm.


ductus arteriosus
sup mes artery
celiac trunk
renal artery
umbilic artery line
internal iliac artery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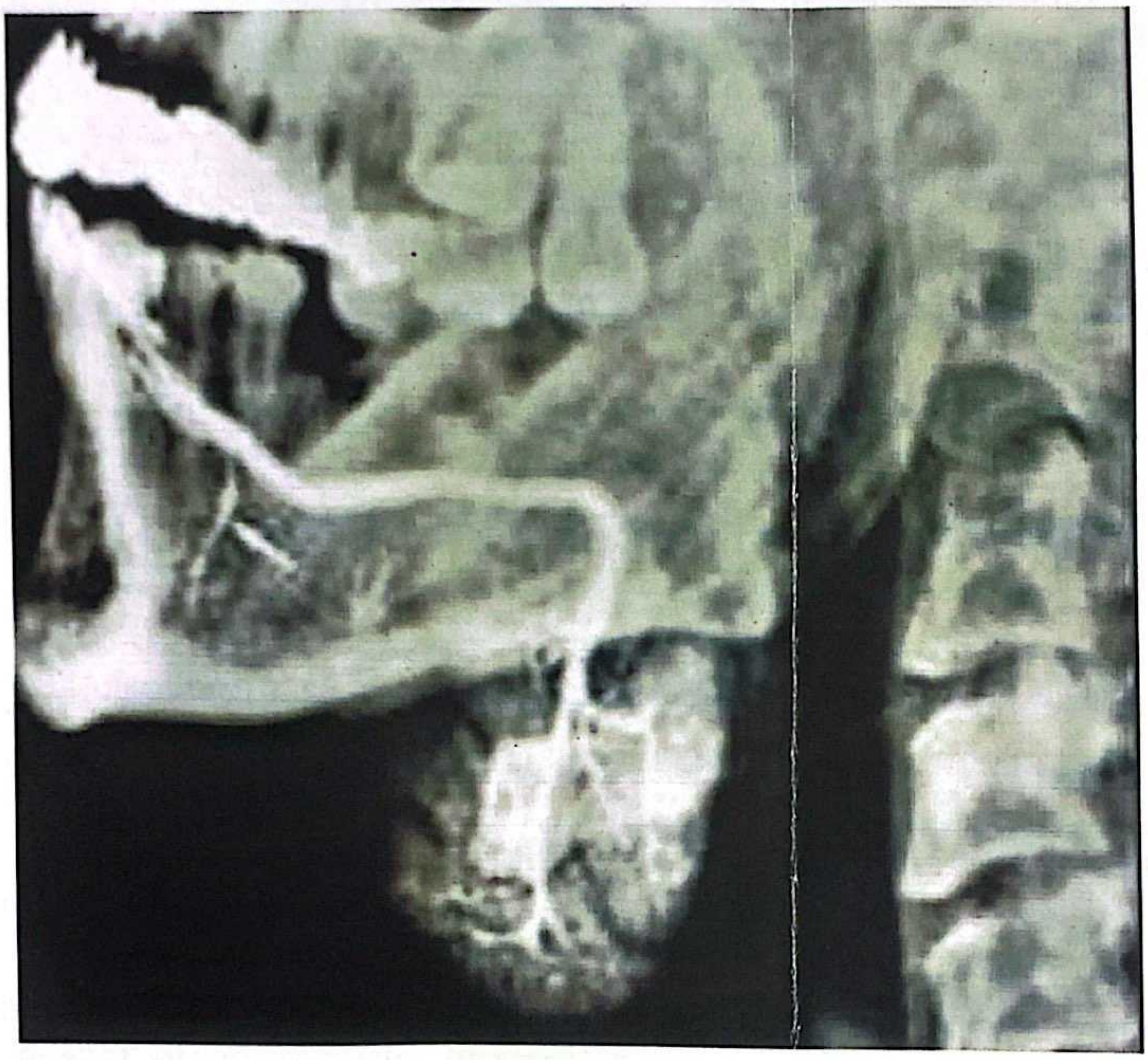
Q.4) Identify **(2014)**



Identify: Lateral Sialograph Image of Submandibular Gland

Definition: Sialography is the imaging of the salivary glands, most commonly the parotid gland & submandibular gland. The salivary ducts are conventionally examined fluoroscopically with high sensitivity, though cross-sectional imaging with CT or MR sialography has also been described.

Indications:

1. Suspected sialolithiasis or salivary duct obstruction
2. Suspected sialadenitis: to identify ductal strictures
3. Suspected sialectasis in chronic inflammatory disorders and autoimmune diseases

Describe:

There are three types:

- Conventional/fluoroscopic sialography (with or without digital subtraction)
- CT sialography (ultrafast technique)
- MR sialography
- In most cases, ultrasound (with sialography, if required) is an appropriate imaging modality for the investigation of ductal pathology. In cases of sialolithiasis, ultrasound of the parotid glands is a useful, readily available, noninvasive, and inexpensive option.

Technique:

Technique of conventional sialography

1. control images are taken with the patient supine to assess for radio-opaque calculi
2. lateral oblique and anteroposterior views
3. using tongue depressors for submandibular
4. the patient may be asked to suck on a lemon or secretory stimulant for 2-3 minutes before sialography
5. to make the salivary duct opening conspicuous for cannulation
6. symptomatic parotid or submandibular duct cannulated
7. 21 gauge catheter for Stensen's duct-parotid gland
8. located adjacent to the crown of the second upper molar in the buccal mucosa
9. 24 or 27 gauge for Wharton's duct-submandibular gland
10. at the base of the frenulum of the tongue
11. up to 2 mL of water-soluble contrast is instilled
12. care should be taken not to introduce air into the salivary ducts, as it can mimic a ductal calculus on sialography

Advantages

1. Higher spatial resolution for superior diagnostic elucidation (when the procedure is successfully achieved) with accurate delineation of second- and third-order branches
2. Enables therapeutic approach in sialoendoscopy for removal of sialoliths, retrograde displacement of sialoliths to relieve acute obstruction, and to dilate strictures

Disadvantages

1. Invasive procedure
2. Substantial failure rate of procedure (especially submandibular sialography) due to cannulation problems, lack of skill, lack of patient compliance, pain, etc.
3. Radiation exposure
4. Contrast media exposure with risk of allergic reaction

Technique of CT sialography

1. Multiplanar data acquisition allows for 3D reconstruction.
2. Intravenous contrast material can be administered for better soft tissue evaluation, especially for parotid masses.

Advantages

1. Assessment of glands other than the parotids is possible
2. Better diagnosis of parenchymal pathology, excellent visualisation of the deep lobe, and better subtraction options
3. No special positioning required

Disadvantages

1. Intravenous atropine is required to minimise run-off of contrast and impair ductal clearance in some cases
2. Radiation exposure

3. Invasive procedure

Technique of MR sialography

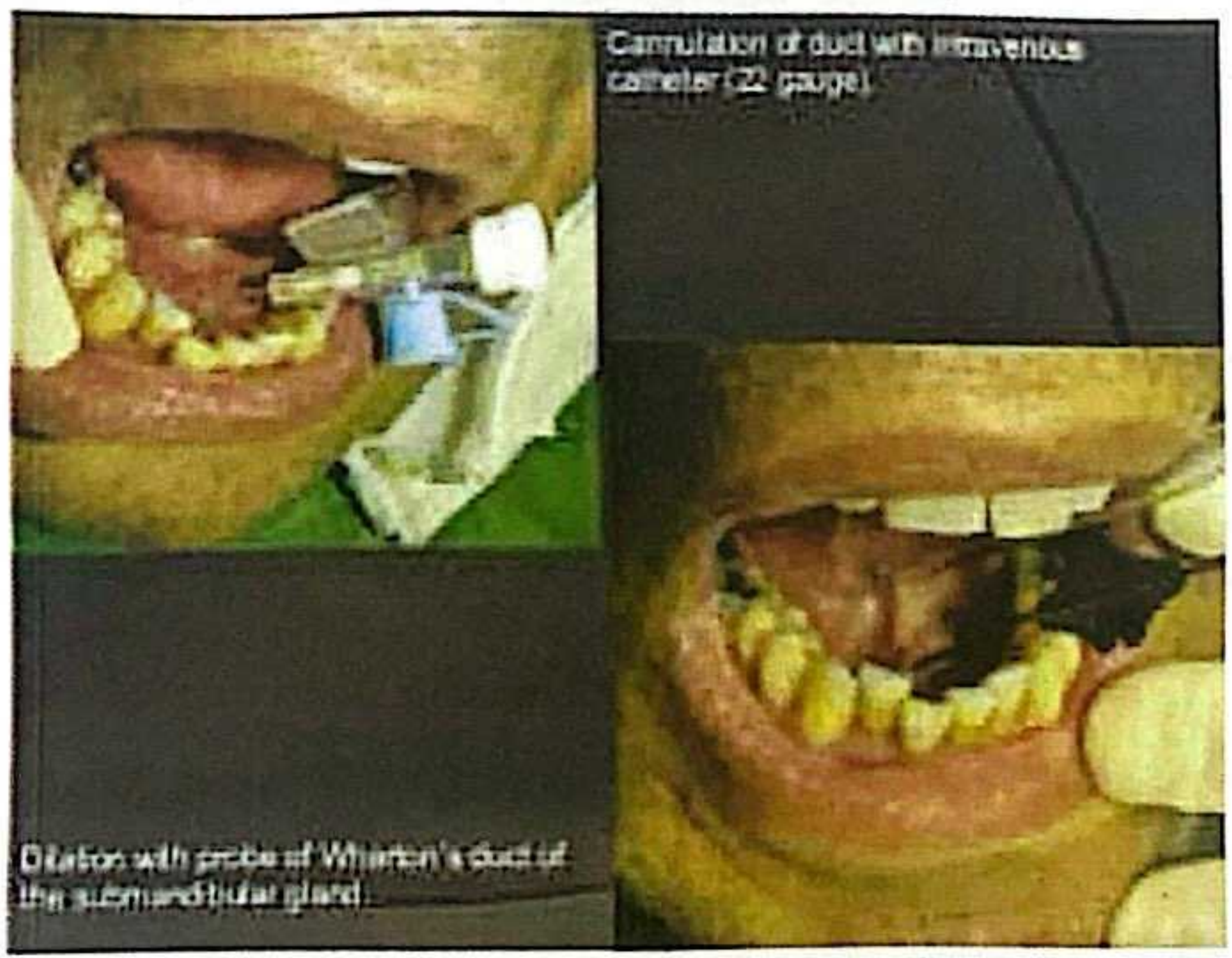
1. MRI sialography is a fairly sensitive and reliable method of evaluating the salivary glands.
2. Fast acquisition heavily T2 weighted sequences (e.g. RARE, CISS, FISP, as used in MRCP and MR urography) brighten intraluminal fluid and display ductal morphology adequately with no need to inject contrast into the ducts.
3. MR contrast administered intravenously is a useful adjunct.

Advantages

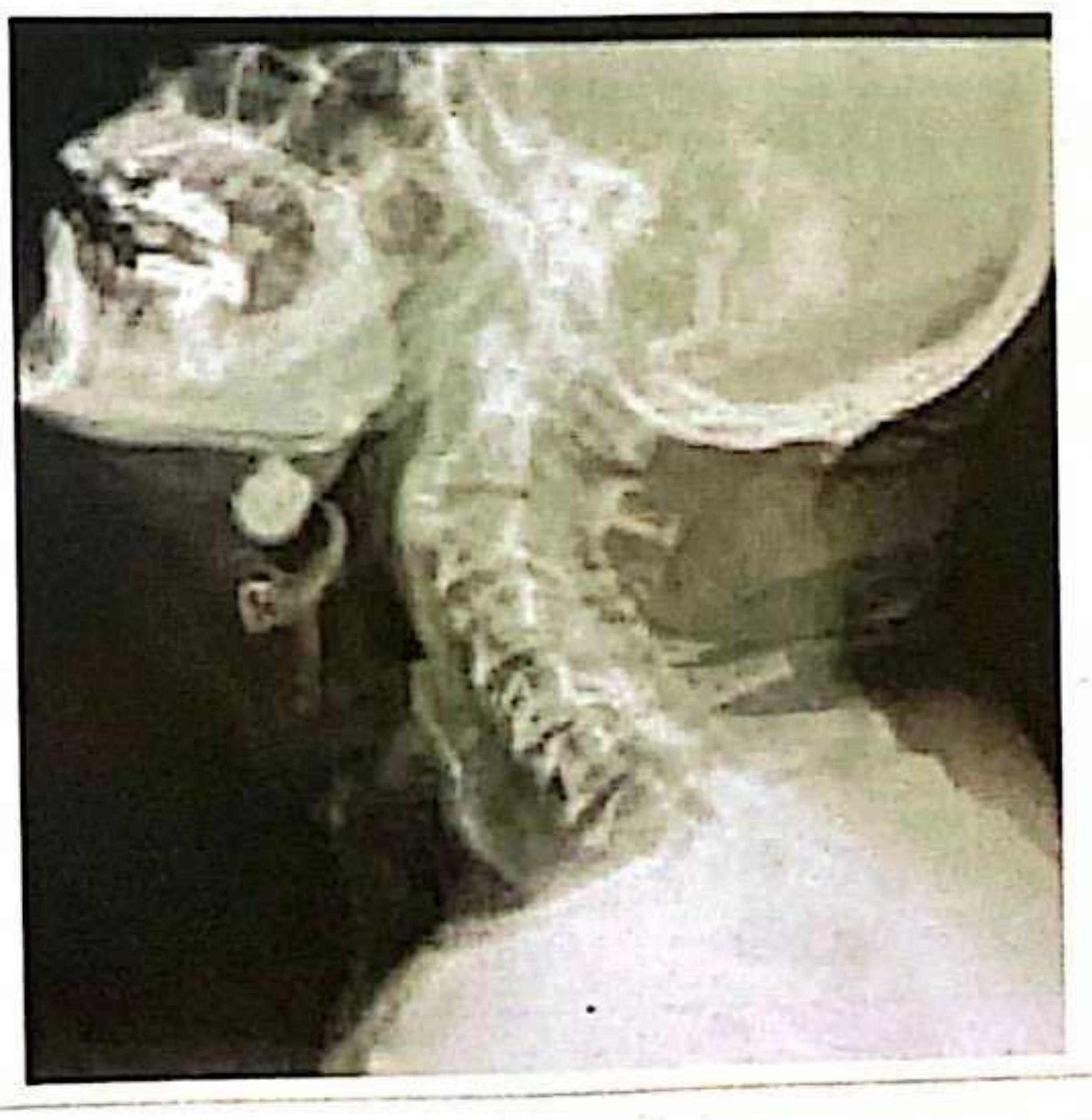
1. Rapid acquisition
2. Non-invasive
3. Assessment of other glands possible
4. Excellent delineation of parenchymal pathology
5. No special positioning required
6. Because no cannulation is required, the risk of air bubbles simulating intraductal calculi is minimized

Disadvantages

1. General MRI contraindications, e.g. pacemakers, implants, claustrophobia
2. Dental fillings, implants, bridges, etc. can cause image impairment
3. Only first- and second-order branches can be delineated

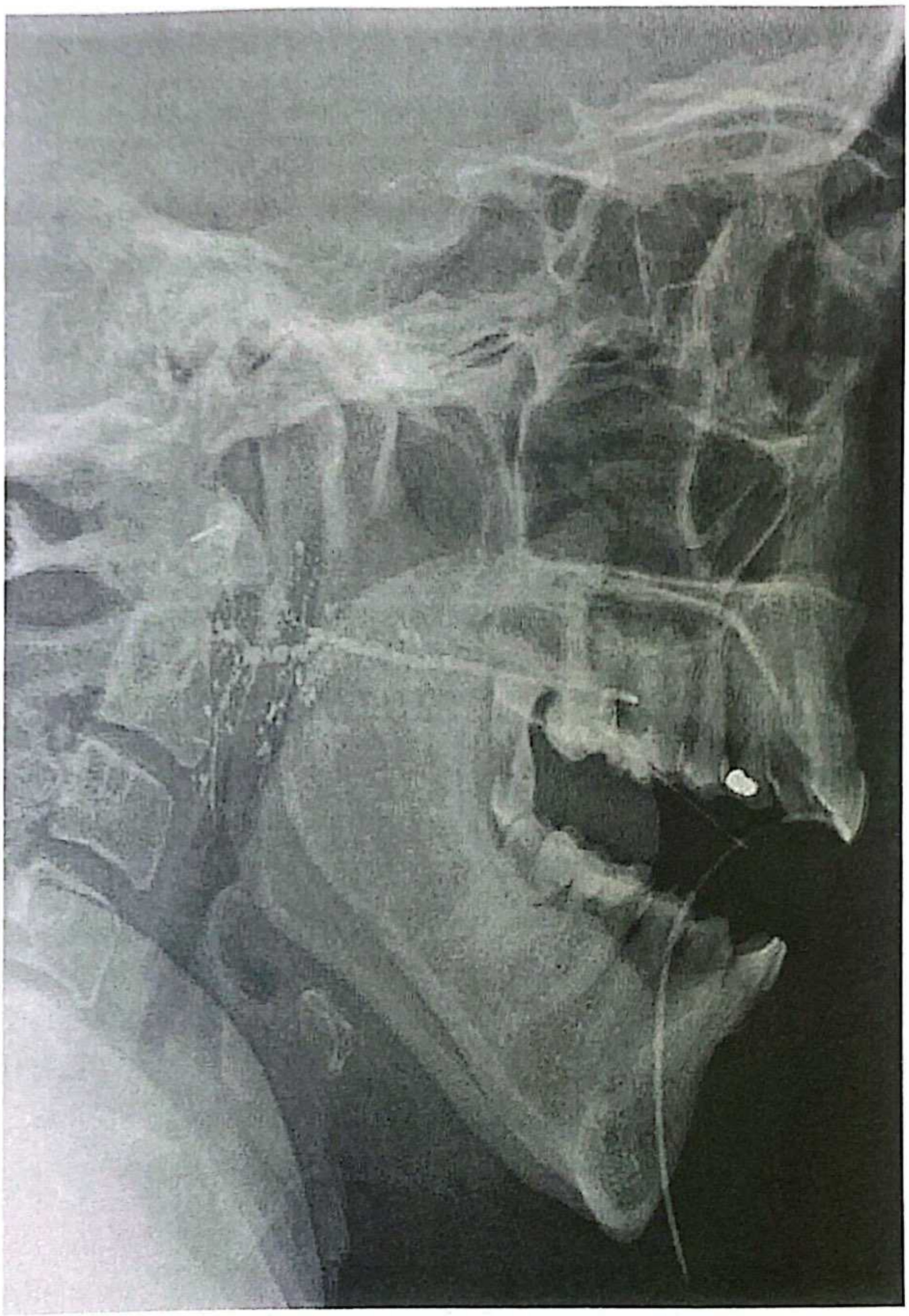

Cannulation of duct with intravenous catheter (22 gauge)
Dilation with probe of Wharton's duct of the submandibular gland

Large right submandibular radio-opaque calculus



Q.5) Complaining of dry eyes and mouth dryness for many years

(2013)



Identify: Sailogram of parotid gland Lateral view image

Describe:

1. No calculus identified radiographically on the preliminary images.
2. Contrast shows the parotid duct to have a fine beaded appearance, with this beading extending into the intraglandular ducts. Contrast spilling into enlarged acini has an "apple tree" pattern.
3. Small filling defects in these distal acini are more likely inspissated content.

Diagnosis: Sjögren syndrome

What next:

MRI

Salivary glands

- Parotid gland involvement may give a salt and pepper appearance or a honeycomb appearance.
- A change in size of the lacrimal glands associated with accelerated fat deposition may also be seen.

Ultrasound

Salivary glands

- early stage: the gland can be normal or become enlarged and hyperechoic
- late stages: may characteristically show a multicystic or reticular pattern within an atrophic gland

Complications

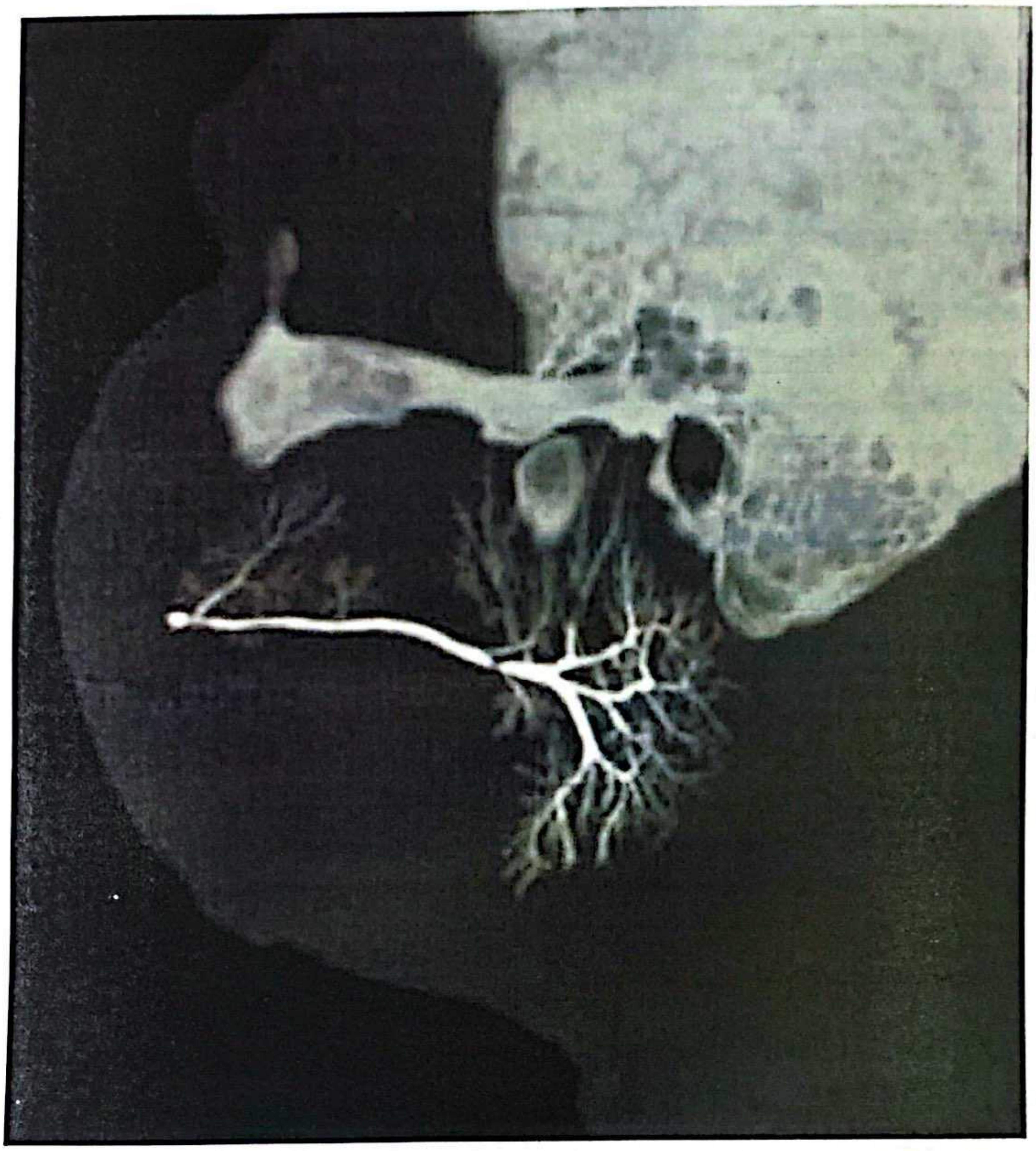
One of the complications of this syndrome is the development of malignant lymphoma.

Associations

1. thoracic changes associated with Sjögren syndrome
2. nonspecific interstitial pneumonitis (NSIP)
3. usual interstitial pneumonitis
4. lymphoid interstitial pneumonia (LIP)
5. focal lymphoid hyperplasia of the lung
6. small airways disease
7. pulmonary amyloidosis
8. systemic lupus erythematosus (SLE)
9. scleroderma
10. rheumatoid arthritis (RA)
11. EBV infection
12. Hepatitis C infection
13. primary biliary cirrhosis

Q.6) Pain parotid region

(2015)

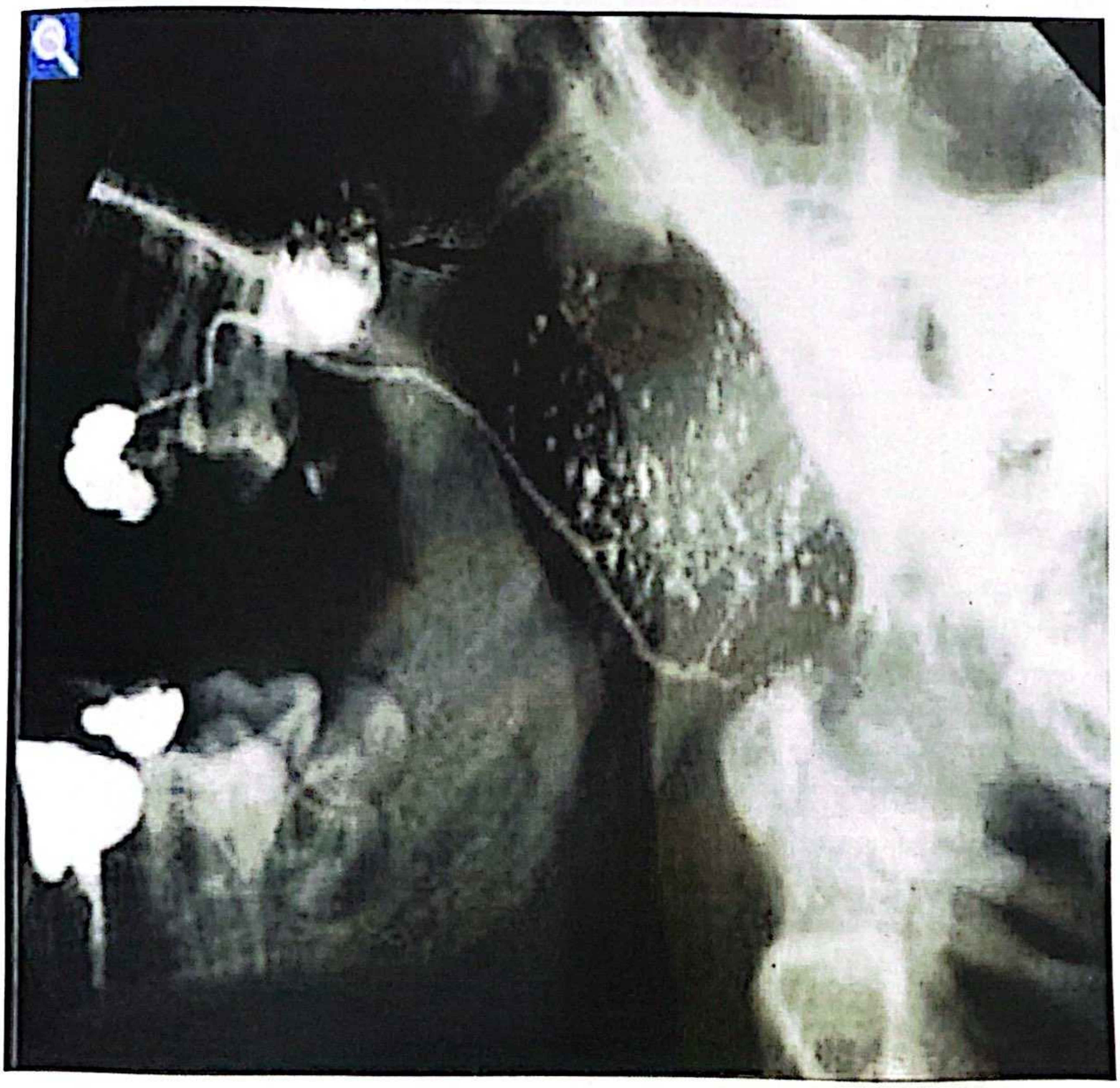


Identify: CT Sailogram of parotid gland Saggital view MIP image

Describe: Connection between the anterolateral portion of the superficial parotid lobe extending to the skin for about 1.3 cm.

Diagnosis: Fistula

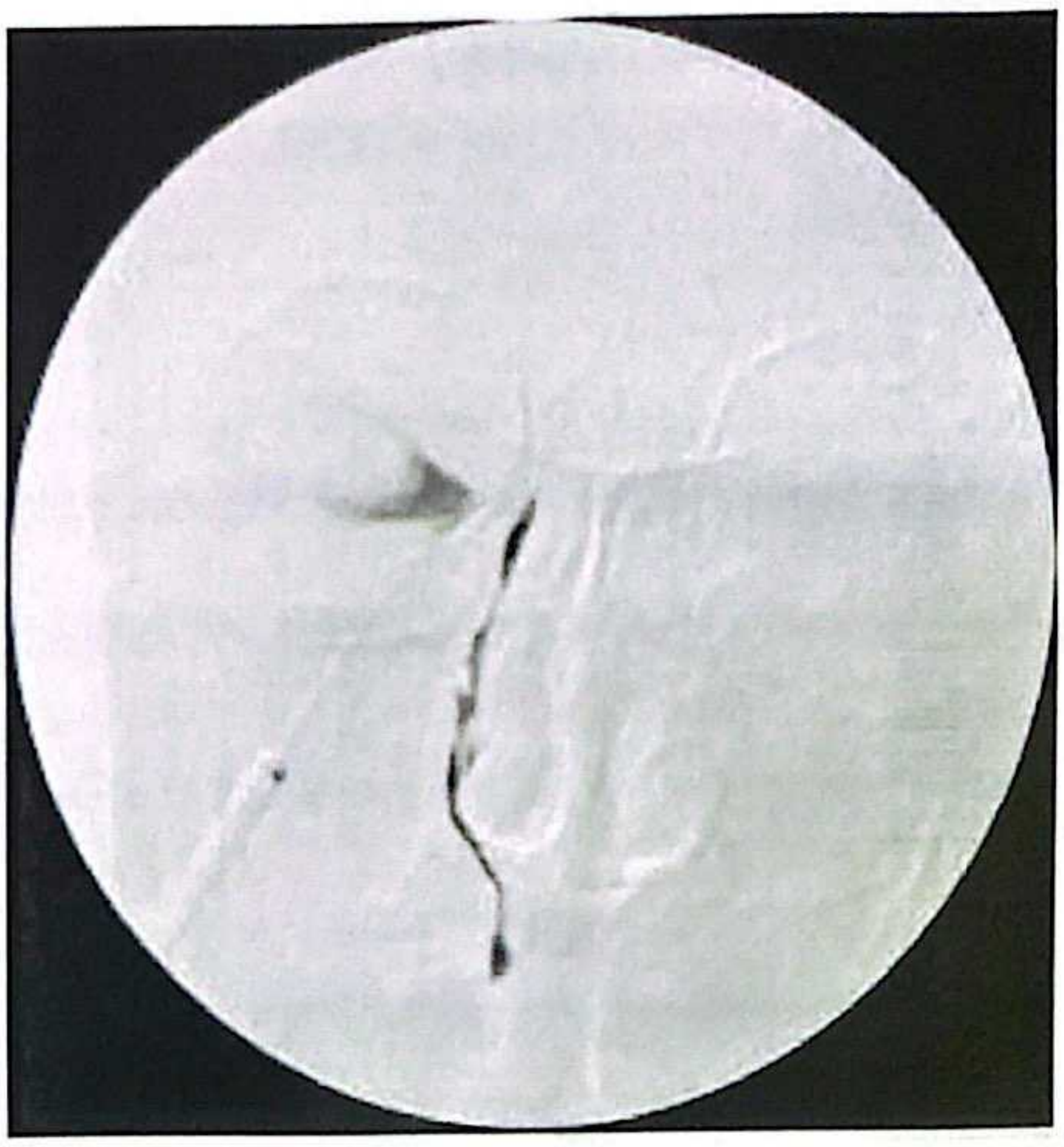
Q.7) **(2013)**



Sialoectasis

Sialogram of the parotid gland; lat. projection. In the glandular parenchyma pools of contrast can be seen. The accessory parotid gland is also affected (arrow).

Q.8) Identify: **(2015)**



Identify: Dacryocystogram

Describe: Free passage of contrast from the right inferior canaliculus into the nasal passage.

Definition: Dacryocystography is a fluoroscopic contrast examination of the nasolacrimal apparatus. The duct is cannulated enabling iodinated contrast to be instilled into the nasolacrimal system.

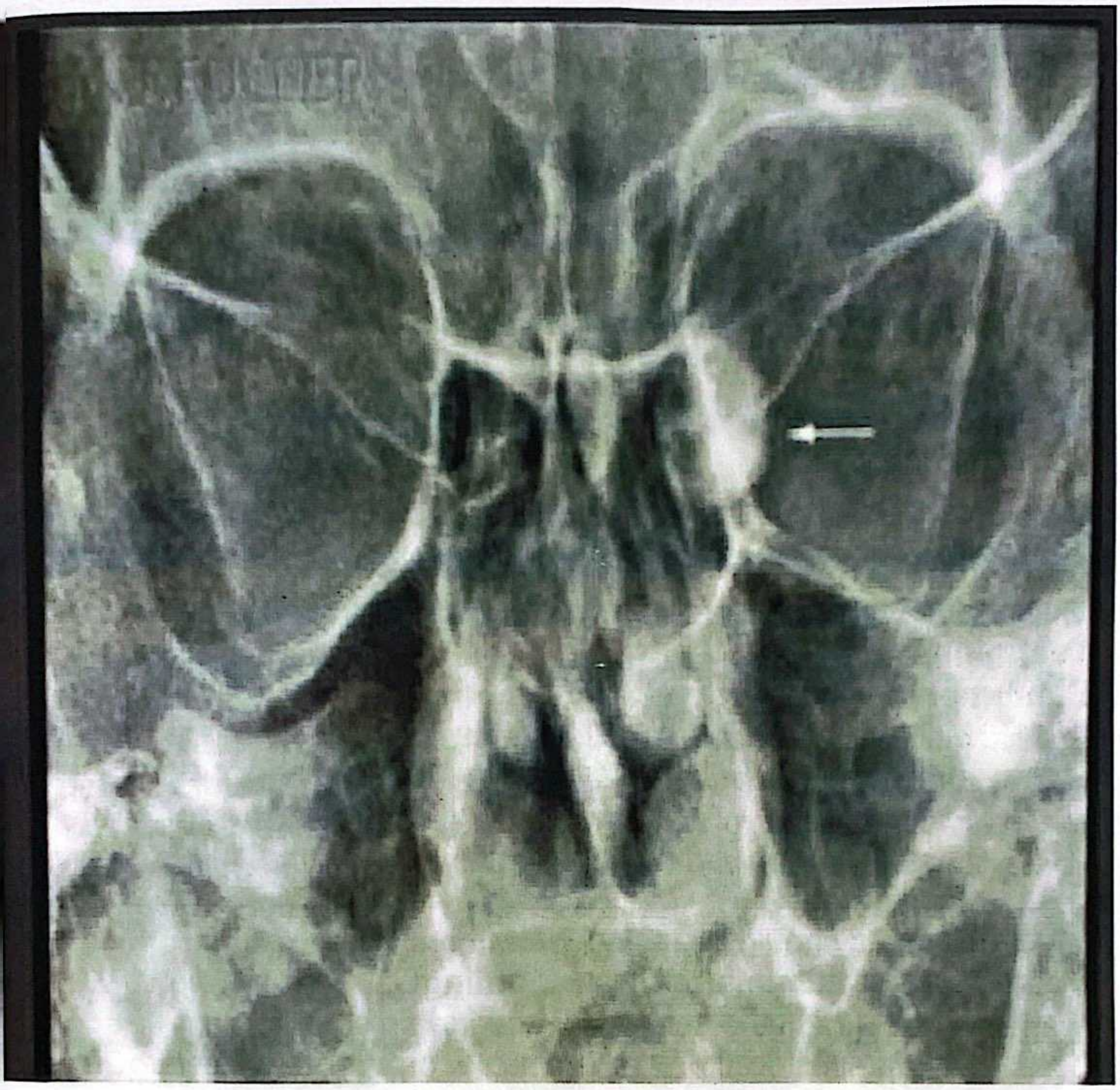
Indications:

The most frequent indication is epiphora: excessive tearing or watering of the eyes.

Technique:

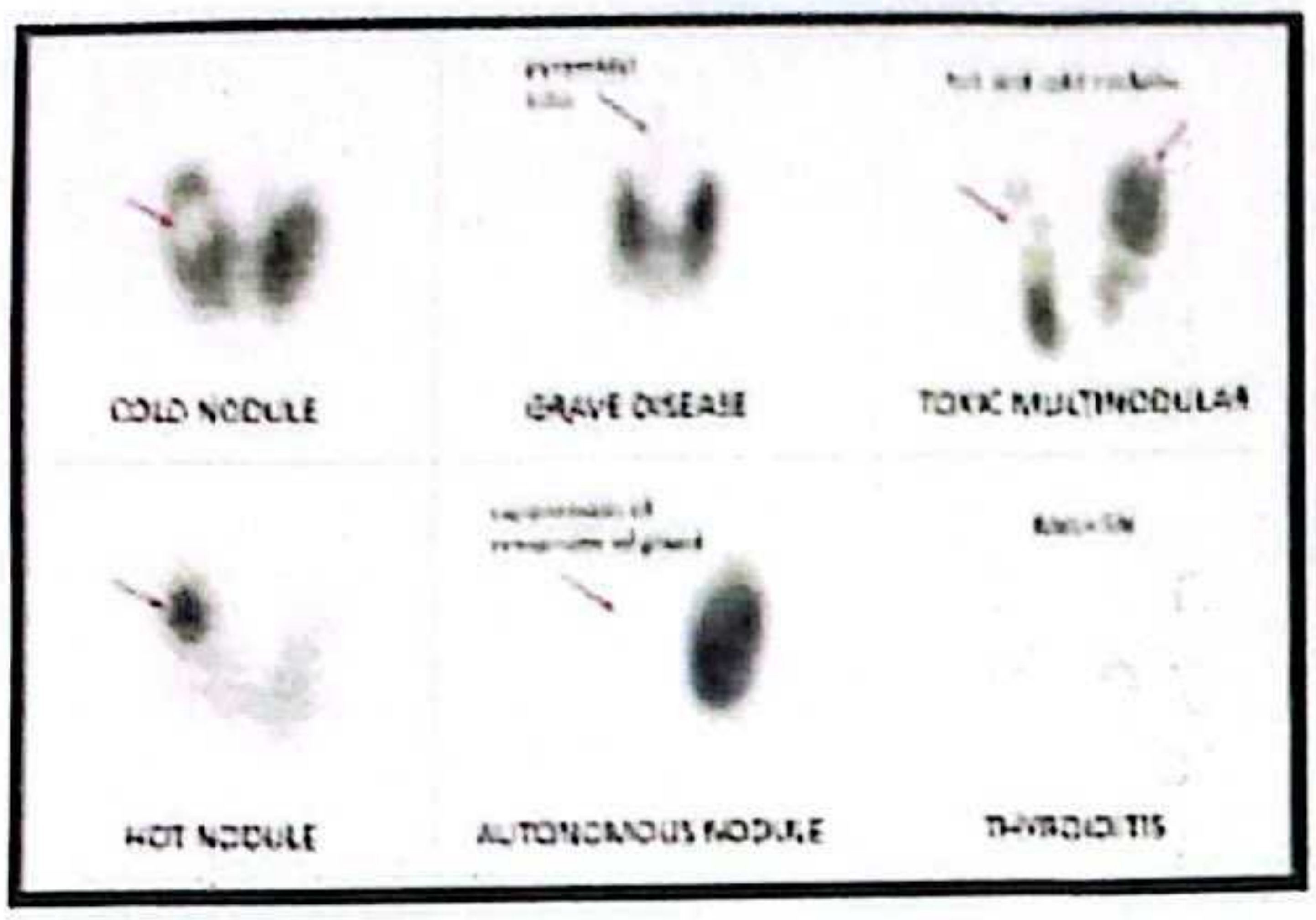
1. Equipment is similar to that used to perform a sialogram 16G Needle.
2. Patient in the supine position
3. Reverse occipito mental view in most cases
4. Small field of view
5. Anesthetic eye drops
6. Acquisition of a preliminary control film to confirm patient positioning and exposure
7. Dilate the punctum to insert the cannula (Inferior puncta easy to cannulate)
8. Non-ionic iodinated contrast injection into a cannulated duct, avoiding air bubbles
9. Acquire images, whilst ask the patient to look straight ahead to avoid blinking
10. A post-removal of cannula erect view may be useful in diagnosing functional blocks

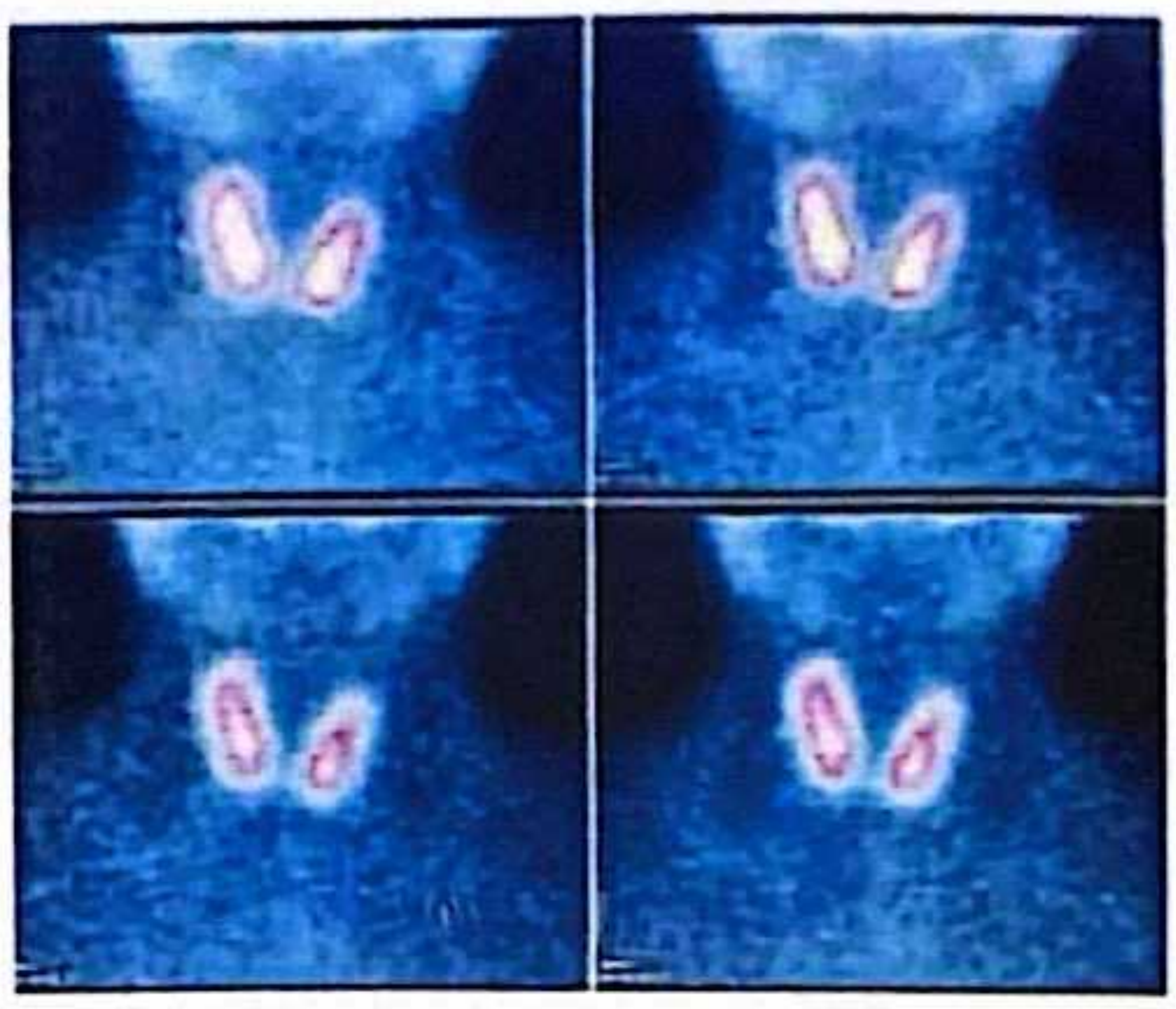
Q.9) **(2014)**



Bilateral dacrocystogram without subtraction
Delayed drainage image
Abnormal accumulation of contrast on the left

Q.10) Identify **(2017), (2018)**





Identify: Thyroid scan

Definition: Thyroid scan (thyroid scintigraphy) is a nuclear medicine examination used to evaluate thyroid tissue.

Technique:

Patient preparation:

1. Medications that interfere with thyroid uptake of radio-iodine should be discontinued.
2. Review of the history should be carried out to ensure the patient has not received iodine-containing contrast (e.g. for CT or angiography).
3. Patients should be fasted for 4 hours prior to study.

Dose, route of administration and timing:

1. Iodine-123 is the commonly used radioisotope.
2. It is administered orally in capsule form (100-400 microCi).
3. Scanning is performed either at 4-6 or 24 hours.
4. An alternative radioisotope is Tc-99m pertechnetate. Administration is intravenous, and imaging must be done early (maximum uptake at about 20 minutes).

Equipment:

- Camera: gamma camera
- Collimator: 3-6 mm aperture pinhole collimator
- Window: 20% energy window centered at 159 keV.

Procedure

1. The patient is positioned supine with the chin up and the neck extended.
2. The collimator is then positioned so that the thyroid fills about two-thirds of the diameter of the field of view.
3. Mark the chin and suprasternal notch.
4. Note the position and mark palpable nodules and surgical scars.
5. Place marker sources lateral to the thyroid to calibrate size.

6. Three views are typically obtained: anterior; 45-degree LAO; and 45-degree RAO (move the collimator, if possible, rather than the patient).
7. Each view should have 100-250k counts.

Indications:

1. Functional status of a thyroid nodule
2. Thyrotoxicosis
3. Thyroid cancer
4. Whole body scan for distant metastases
5. Estimation of local residual thyroid post thyroidectomy
6. Follow-up for tumour recurrence

Contraindicated in pregnancy and requires precautions if breast feeding

Iodine-123

- Iodine123 (I123) is a radioisotope of the element iodine used to scan the thyroid gland.

Uses, dosages, and time of Imaging

- Routine scan: 100-400 microci po, image at 4-6 or 24 hours
- Thyroid cancer scan: 1.5 mci po, image at 4-6 or 24 hours
- Photon energy: 159 kev
- **Physical half-life: 13 hours**

Normal distribution

1. Thyroid gland (target organ)
2. Nasopharynx
3. Salivary glands
4. Stomach (target organ)
5. Colon
6. Bladder (target organ)
7. Lactating breasts

Pharmacokinetics

- Iodine-123 is rapidly absorbed from the gastrointestinal tract, with detectable activity in the thyroid gland within minutes. It reaches the thyroid follicular lumen in 20-30 min, with rapid trapping and organification.

Excretion

Excretion is primarily renal. It should be noted that it is also secreted in breast milk and crosses the placenta. As such it is contraindicated in pregnancy and requires precautions if breast feeding.

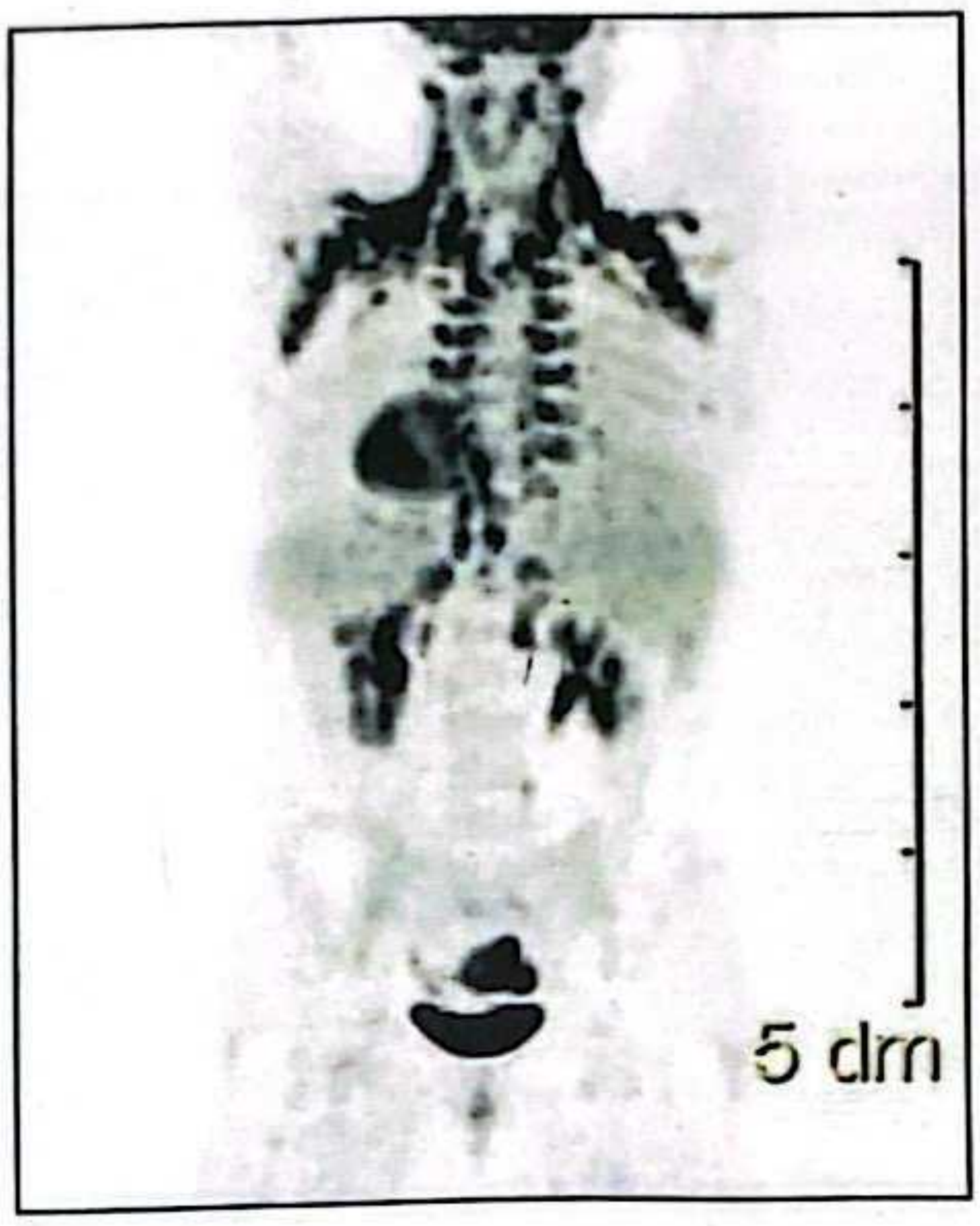
Tc-99m pertechnetate

- Tc-99m pertechnetate is one of the technetium radiopharmaceuticals used in imaging of thyroid, colon, bladder and stomach.

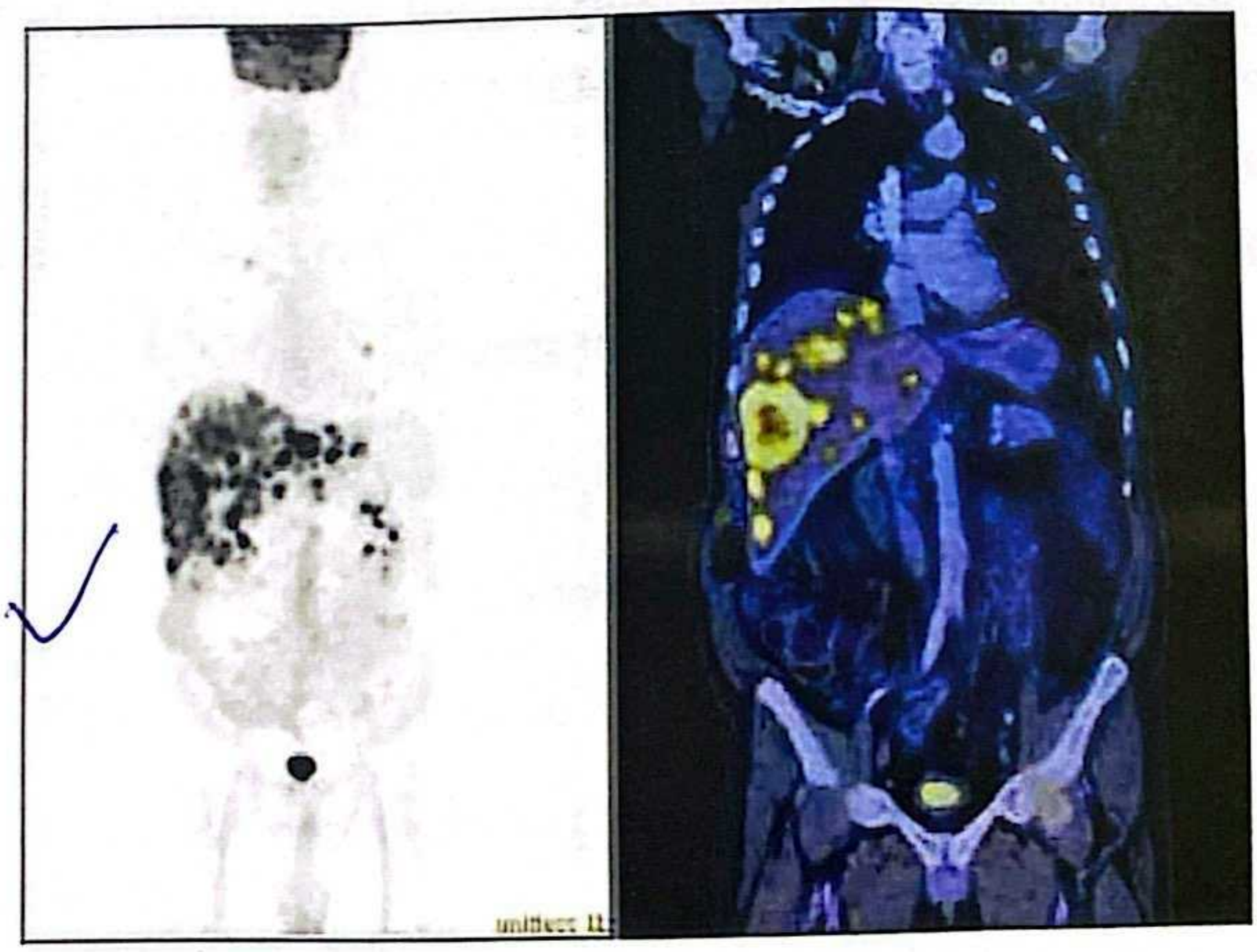
Characteristics

- Photon energy: 140 kev
- **Biological half-life: 6 hours**

Q.12) Identify **(2017), (2014)**



There is diffuse symmetric bilateral FDG uptake within the mediastinum, neck and upper chest, paraspinal muscles and retroperitoneum corresponding to brown fat activity. The soft tissue uptake is clearly localized within the fatty tissue as demonstrated by PET/CT co-registration.



Multiple FDG avid hepatic focal lesions with elevated standardized value uptake (SUV max 15) representing metastatic focal lesions.

Multiple small FDG avid bilateral pulmonary nodules, (well demonstrated at the CT chest images) (Not shown)

dentify: Positron emission tomography (PET) Scan

Definition: A modern non-invasive imaging technique for quantification of radioactivity in vivo. It involves the use of a radiopharmaceutical injected into the body and its accumulation in the body is detected, quantified and interpreted.

Describe:

- A radiolabeled bio compound such as 2-fluoro-2-deoxy-D-glucose (FDG) is injected intravenously.
- Uptake of this compound followed by further breakdown occurs in the cells. Tumour cells have a high metabolic rate, and hence this compound is also metabolised by tumour cells.
- FDG is metabolised to FDG-6-phosphate which cannot be further metabolised by tumour cells, and hence it accumulates and concentrates in tumour cells. This accumulation is detected and quantified.
- Radiopharmaceutical detection
- FDG decay in the body with the release of a positron, i.e. a beta particle. The beta particle travels a short distance and annihilates with an anti-particle (electron). The annihilation reaction results in the formation of two high energy photons which travel in opposite directions.
- Each photon has an energy of 511 keV. Two detectors at opposite ends facing each other detect these two photons travelling in opposite directions, and the radioactivity is localised somewhere along a line between the two detectors. This is refered to as the line of response

Technique:

1. Fasting for 4-6 hours
2. Blood glucose level < 150 mg/dl ✓
3. Avoid strenuous activity 24 hours prior to imaging ✓
4. Avoid speech 20 minutes prior to imaging
5. The scan is carried out 60 minutes post injection of FDG
6. Dose: 10 mCi (370 MBq)
7. Physical half-life: 110 min
8. Imaging time: 45-60-70 min after administration

370MBq

Indications:

Oncologic

1. Detection, **STAGING**, drug response
2. Differentiation between radiation necrosis and recurrence

Neurologic

3. Early diagnosis of alzheimer's disease
4. Localisation of seizure focus in interictal phase
5. Localising eloquent areas (e.g. Speech, motor function)

Cardiac

6. Identification of hibernating myocardium

Contraindicated in pregnancy and requires precautions if breast feeding

A diffuse homogeneous bone marrow FDG uptake usually reflects hyperplastic bone marrow which can be seen in the following conditions:

1. Therapy-related
2. Granulocyte colony stimulating factor (g-csf)
3. Post-chemotherapy
4. Erythropoietin
5. Pathological process
6. Myelodysplastic syndromes
7. Beta thalassemia
8. Chronic myeloid leukaemia (cml)
9. Interleukins in pyrexic states
10. Cytokines in tumours
11. Diffuse marrow metastases (less likely)
12. Severe anaemia (hyperplastic marrow)

Anemia
Cancer
Post chemo

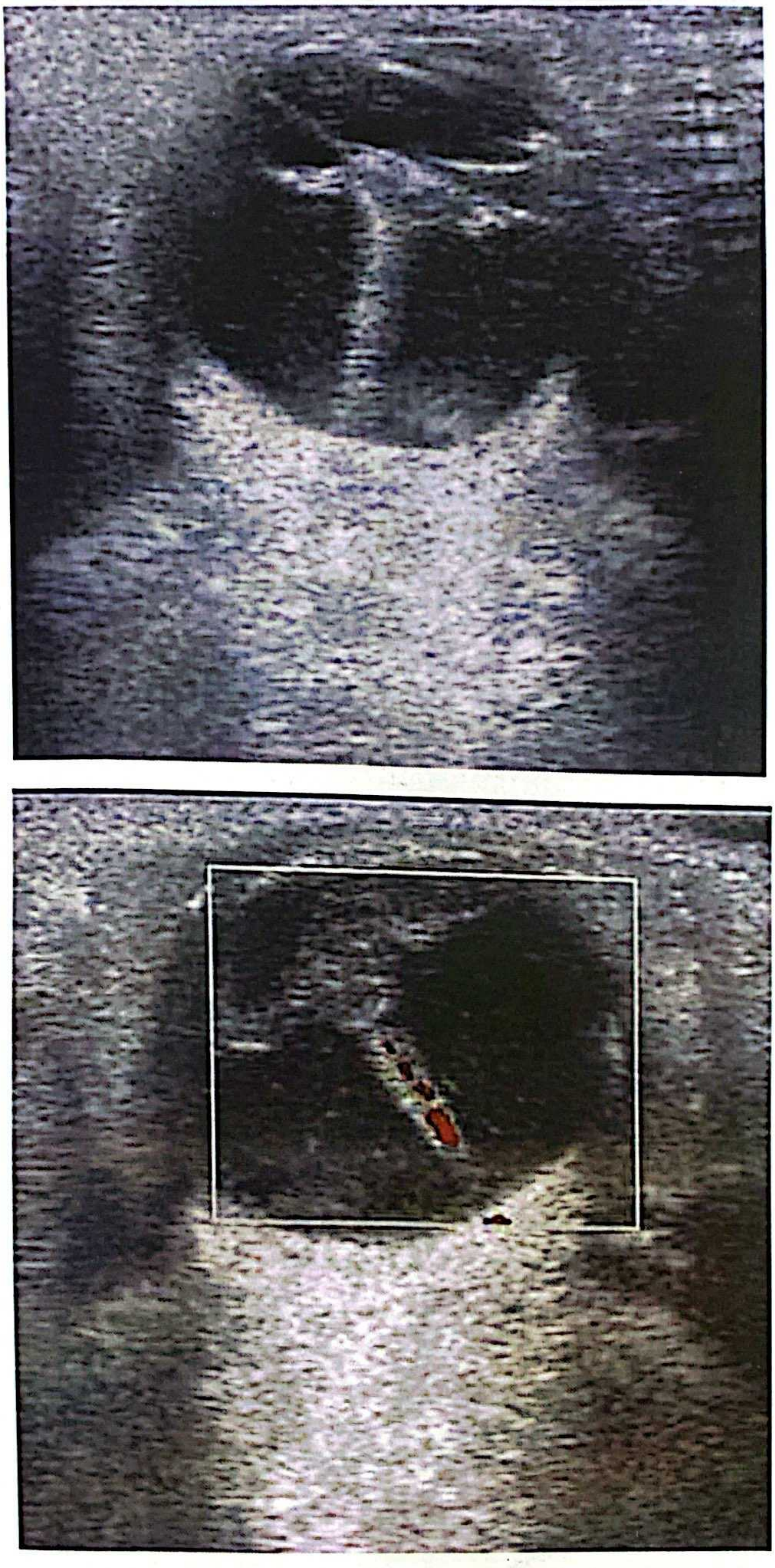
Normal physiological uptake

1. Brain tissue
2. Skeletal muscle, especially after strenuous activity and laryngeal muscles following speech
3. Myocardium
4. Gastrointestinal tract, e.g. Intestinal wall
5. Genitourinary tract: FDG is excreted via the renal system and passes into the collecting systems
6. Brown fat
7. Thymus
8. Bone marrow

False-positive FDG uptake

1. Granulomatous disease
2. Abscess
3. Surgical changes
4. Foreign body reaction
5. Inflammation

Q.13) Identify: **(2017)**



Identify: B-Scan Ocular Ultrasound showing transverse and oblique images

Describe:

1. An elongated thick echogenic band is seen in the posterior segment extending from the lens up to the optic nerve head.
2. This echogenic band shows a small sized artery showing continuous biphasic blood flow on doppler.
3. The ciliary process is thick and echogenic.
4. Lens is small, echogenic with irregular contour.
5. The right eye globe is small in size.

Diagnosis: Persistent hyperplastic primary vitreous

What next:

CT:

1. Soft-tissue replacement (infiltration) of the vitreous body
2. Retrolental soft tissue along the cloquet canal: fine linear structure
3. Extending from the head of the optic nerve to the posterior surface of the lens 3
4. Absence of abnormal calcification within the orbit
5. Microphthalmus
6. Retrohyaloid layered blood
7. Hypervascularity of the vitreous humor: after contrast administration, the vitreal abnormalities may enhance, which is believed to reflect a persistent hypervascular vitreous
8. Retinal detachments can be hyperdense on ct

MRI:

On MRI the retrolenticular tissue characteristic of this condition has a triangular shape, like that of a martini glass appearing as low T2 low signal against the normal high T2 signal of the globe.

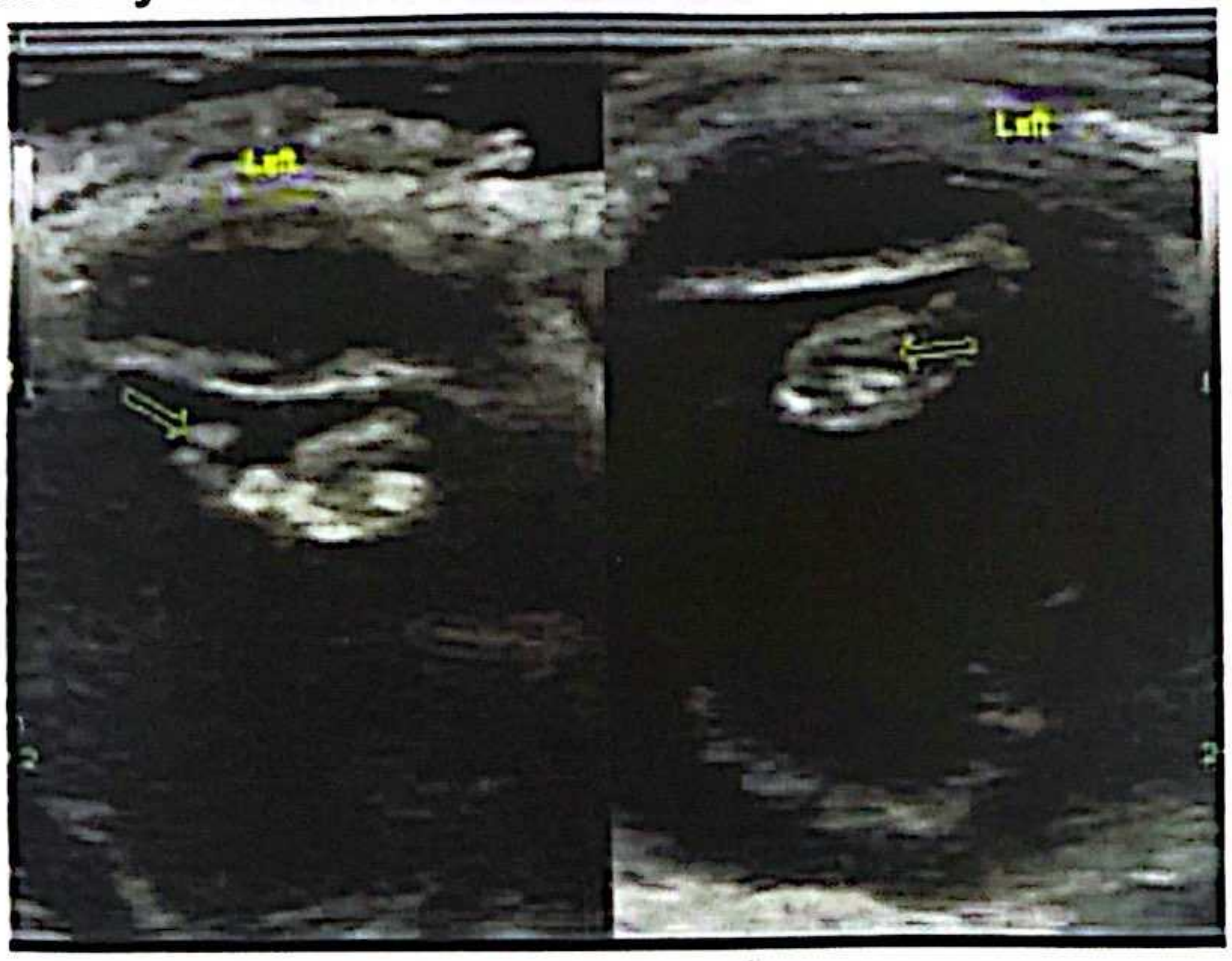
Differential diagnosis:

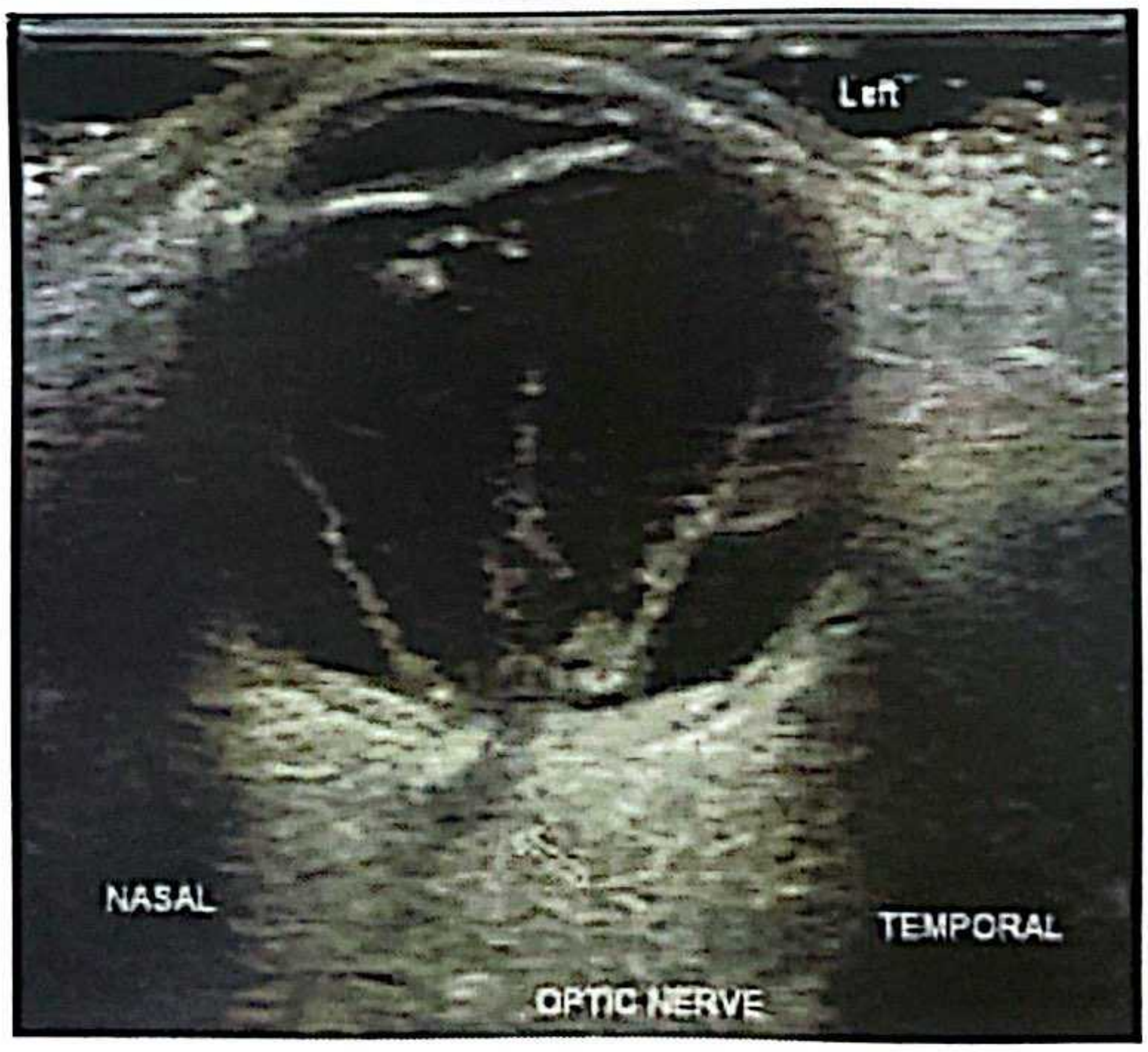
1. Retinoblastoma
2. Retinal detachment

Complications:

Persistence of this leads to fibrosis resulting in cataract, retinal detachment, and ciliary process hypertrophy.

Q.14) Identify: **(2015)**





Identify: B-Scan Ocular Ultrasound showing transverse and oblique images

Describe:

1. Globe is normal size and contour.
2. No intraocular lens is seen. Instead, altered contour with echogenic material in location of lens.
3. A 'V' shaped thick membrane is noted in all quadrants.
4. No after movements are noted in this membrane, indicating retinal detachment.
5. Vitreous membranes are noted with 'v' shaped thick membrane. They show 'after movements'.

6. Another thick membrane is noted outer to retinal detachment on temporal side, indicating choroidal detachment. No after movements are noted in this membrane.

Diagnosis: Retinal and choroid detachment

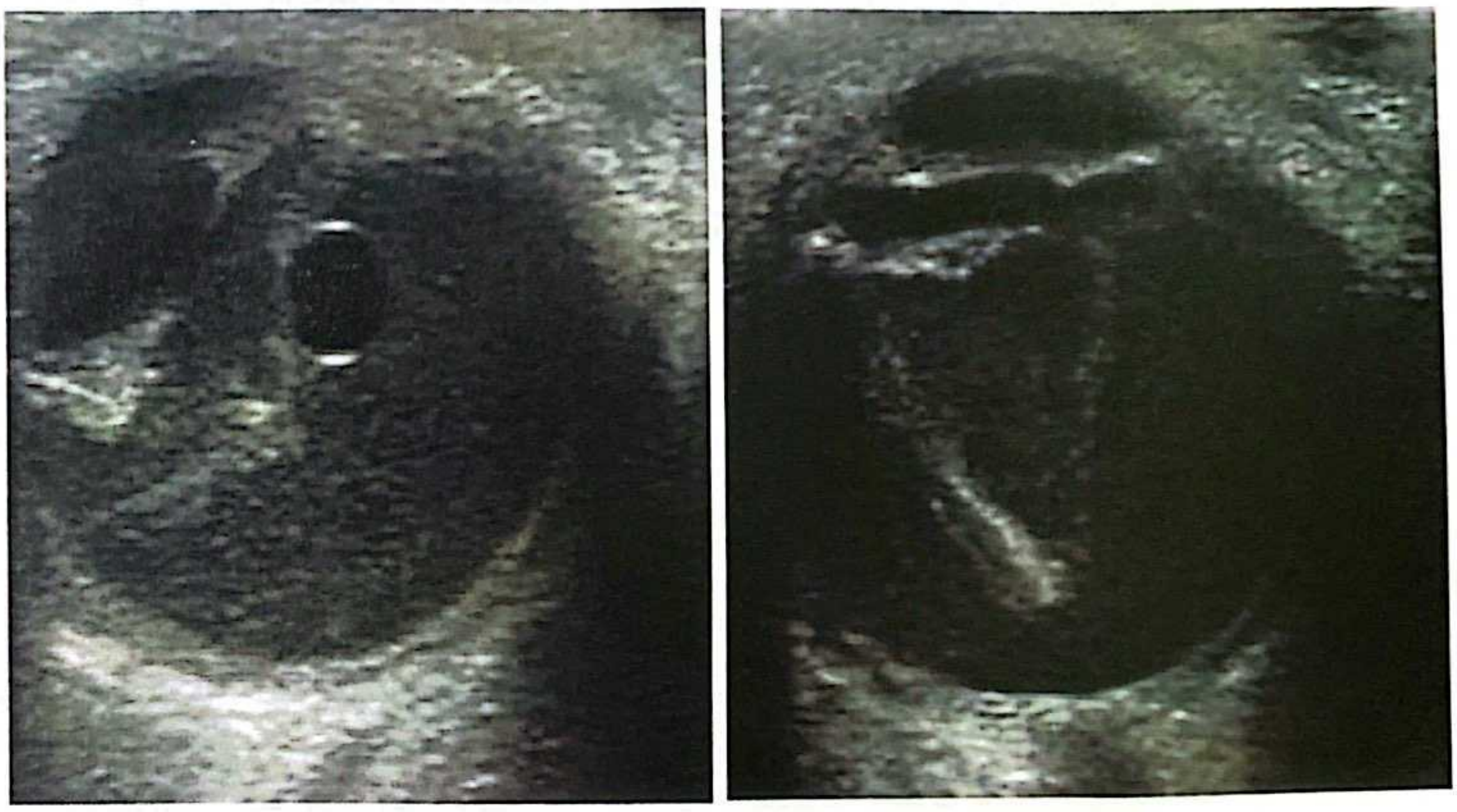
What next:

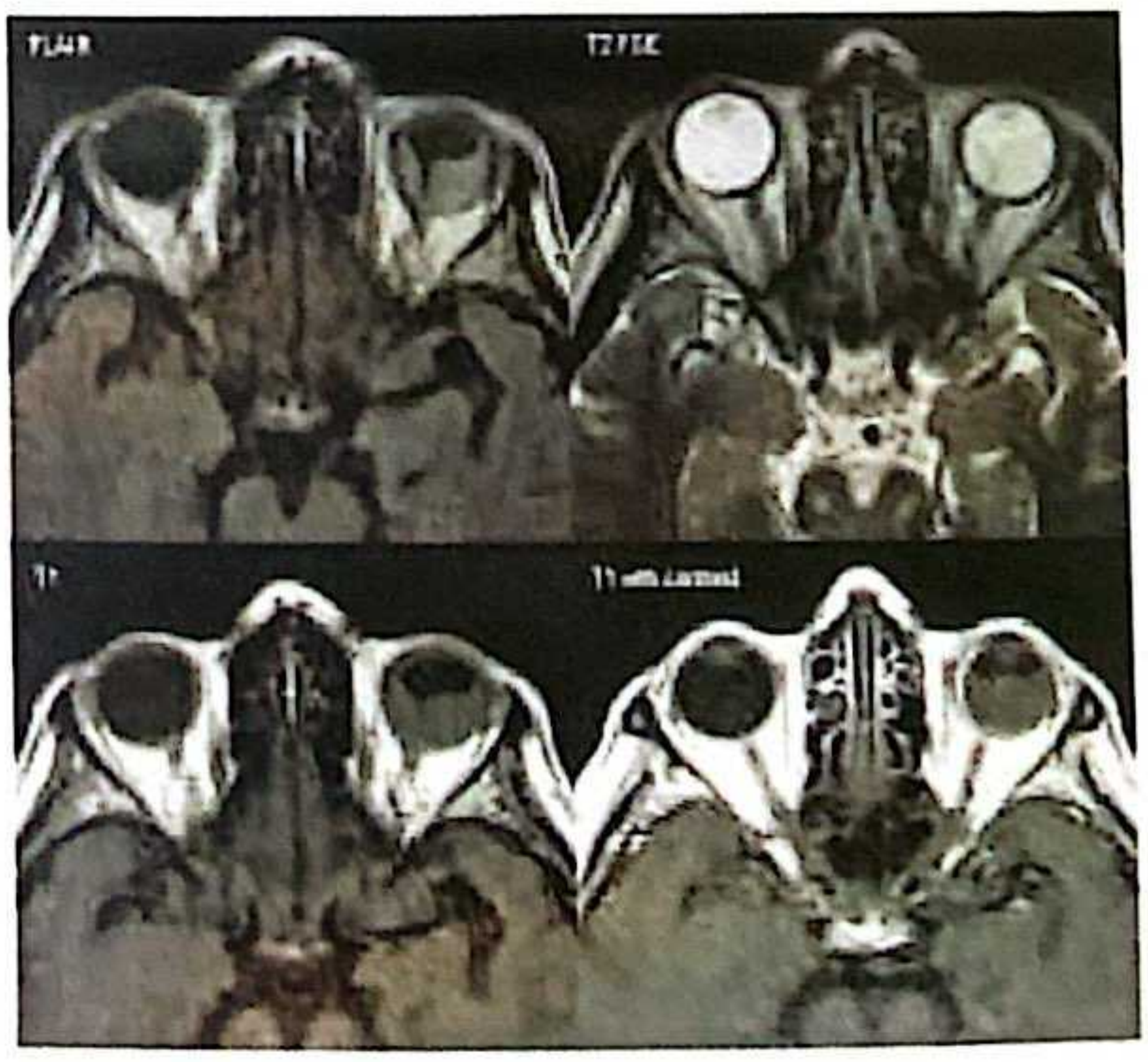
CT/MRI

1. Folded membranes with subretinal space fluid (which is usually hyperdense on CT)
2. The detachment is limited anteriorly by the ora serrata
3. Posteriorly the detachment converges on the optic disc

Treatment:

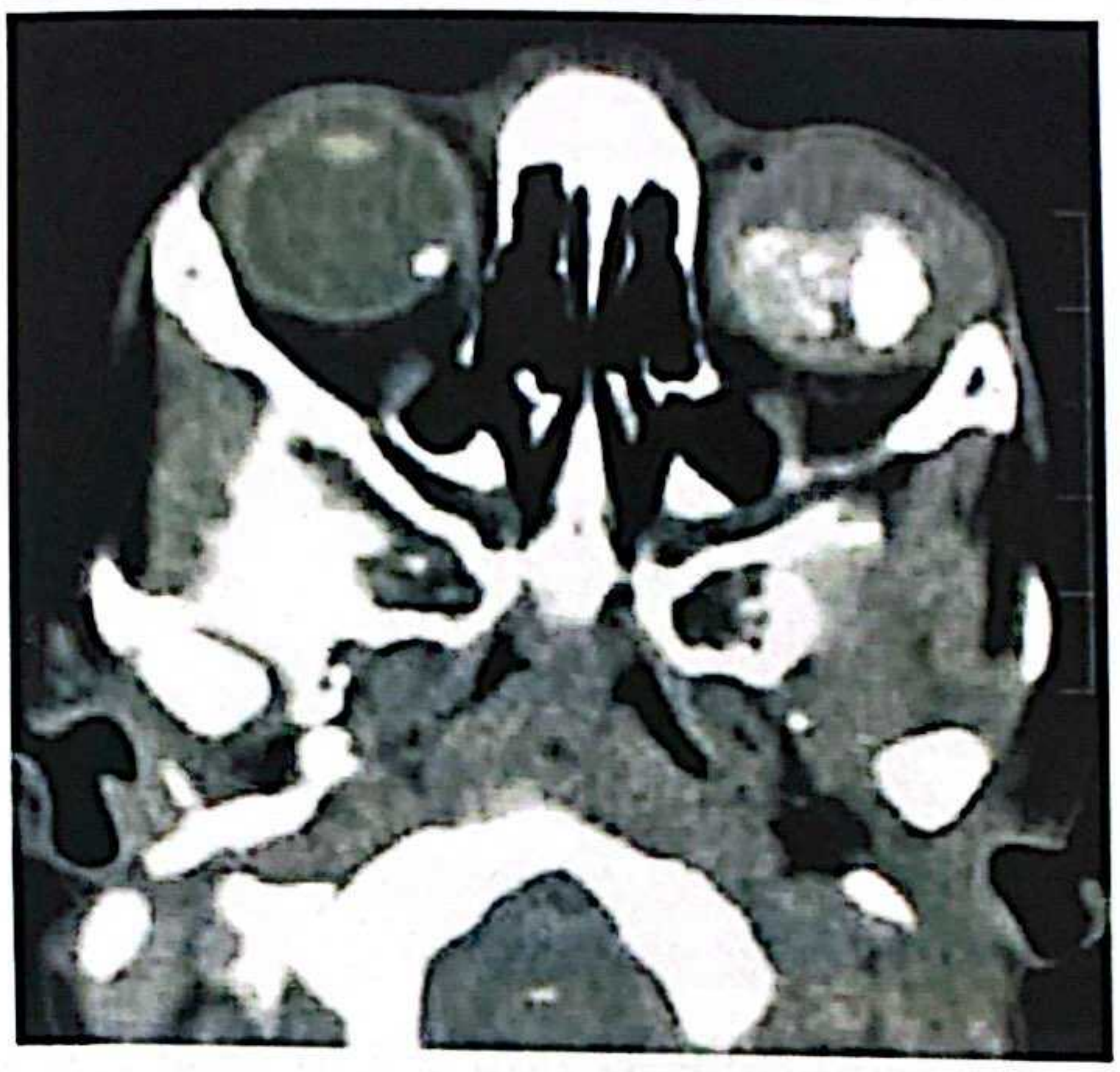
1. Reattachment of the retina using intraocular gas, lasers, cryotherapy or surgery.
2. Most post treatment CT scan may sometimes show a scleral band that is sometimes used as part of treatment (scleral buckle surgery)

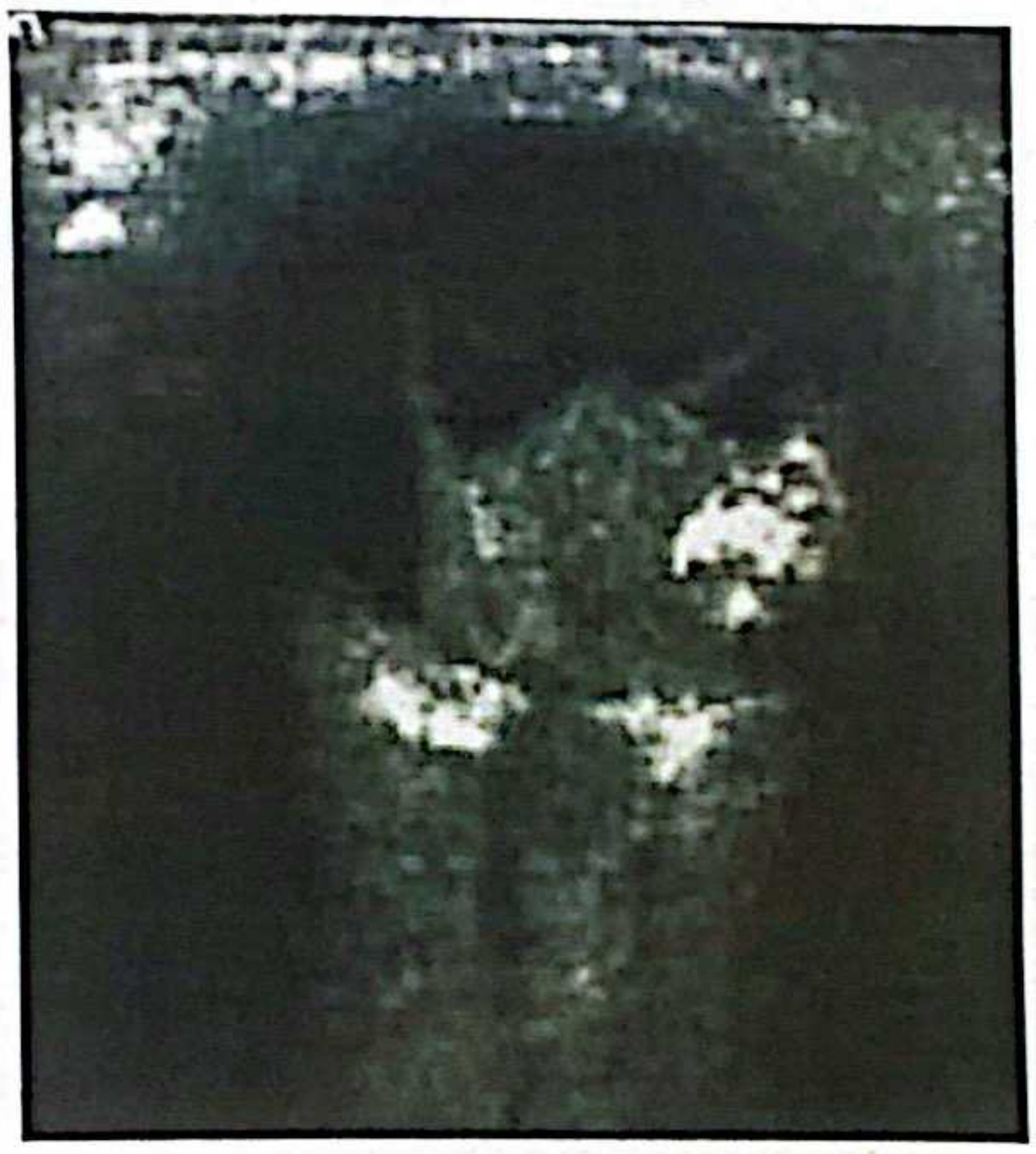




Q.15) Left eye swelling and visual disturbance child 2 year

(2016)





Identify: B-Scan Ocular Ultrasound & Axial CT Head
Describe: Orbital sonography can be performed without sedation and can be repeated multiple times without exposing the child to ionising radiation. Retinoblastomas appear as echogenic soft-tissue masses with variable shadowing due to calcifications and heterogeneity due to necrosis and haemorrhage. At diagnosis, tumours are usually vascular on Doppler examination.
The vitreous may have multiple areas of 'floating' debris, which may represent vitreous seeding or, alternatively, necrotic debris, haemorrhage or increased globulin content.
Diagnosis:

CT demonstrates a contrast-enhancing retrolental mass that is usually calcified. A dense vitreous due to haemorrhage is also common.

MRI is the modality of choice for pre-treatment staging on retinoblastoma

T1: intermediate signal intensity, hyperintense c.f. vitreous 4-5

T2: hypointense c.f. vitreous

T1 C+ (Gd)

1. The mass usually enhances relatively homogeneously when small
2. Larger tumours often have areas of necrosis, rendering it heterogeneous
3. Linear enhancement of the choroid beyond the margins of the tumour should raise the possibility of choroidal involvement, although inflammation may lead to similar appearance

DWI The tumour shows restricted diffusion on DWI at high b values. It exhibits low ADC values in contrast to the high intensity of the vitreous in the ADC maps

ADC map can be used to differentiate viable and necrotic tumour

Treatment

Conservative

1. External-beam radiation therapy
2. Cryotherapy
3. Laser photocoagulation
4. Radioactive plaque therapy
5. Thermochemotherapy
6. Tumour reduction chemotherapy

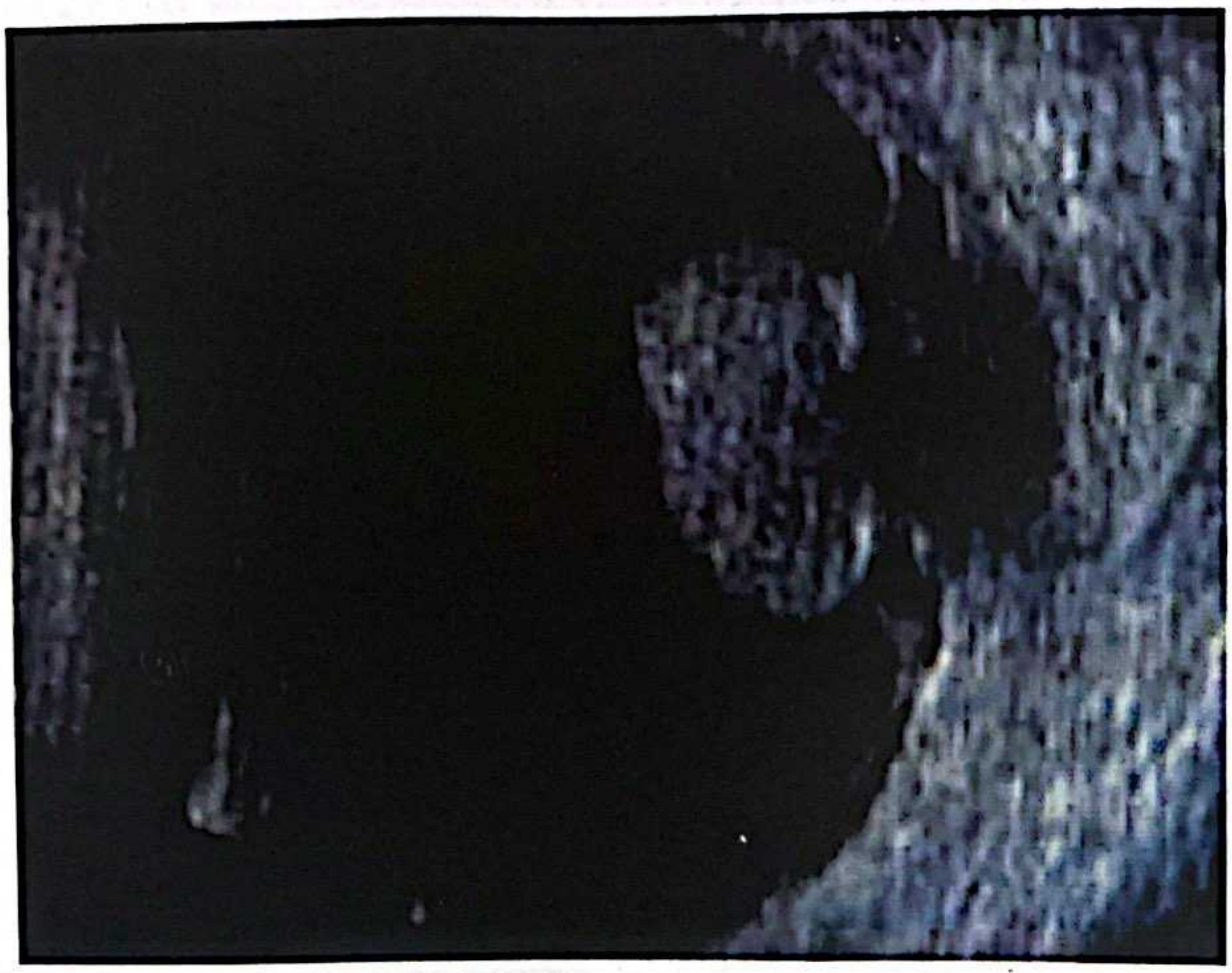
Surgical

7. Enucleation
8. En bloc resection

Differential diagnosis:

1. Drusen
2. Retinocytoma
3. Tuberous sclerosis
4. Epiretinal membranes
5. Retrolental fibroplasia (retinopathy of prematurity)
6. Coats disease
7. Choroidal osteoma
8. Choroidal angioma

Q.16)



Ultrasound

1. Solid low to medium echotexture
2. Internal vascularity
3. Collar button shape
4. This is the classic shape but not always the case
5. Represents the tumour having broken through bruch's membrane
6. Tumours may be irregular, lobulated or domed
7. Other features sometimes present include retinal detachment, posterior scleral bowing, choroidal excavation and vitreous or subretinal seeding. Additionally, larger tumours are often significantly sound attenuating

CT

CT is able to identify most uveal melanomas which appear as elevated, hyperdense sharply marginated lenticular or mushroom shaped lesions, which enhance with the administration of contrast.

MRI is the modality of choice for assessment of malignant uveal melanomas

T1 or PD: uveal melanomas are seen as moderately high signal mass lesion (melanin and haemorrhage are responsible for the high signal)

associated exudative retinal detachment is moderately high signal

T2: moderately low signal mass lesion

associated exudative retinal detachment is moderately high signal

haemorrhagic subretinal fluid has a variable signal pattern

T1 C+ (Gd): tumours enhance

fat suppression useful in detecting extraocular extension

Treatment

Photocoagulation, transpupillary thermotherapy (TTT), brachytherapy, local excision, or enucleation

Q.17) A 60-year-old male has been referred for contrast enhanced MRI of brain. His weight is 60 kg.
What are adverse effects of contrast agents? (2016)

Adverse reactions

- Gadolinium contrast agents are very safe and well tolerated; they have a much lower incidence of adverse reactions than iodinated contrast agents. Adverse reactions to gadolinium are mostly mild and self-limiting and can be divided into acute and delayed reactions.

Acute adverse reactions

1. Urticaria and rash
2. Nausea/vomiting
3. Dizziness and confusion
4. Dyspnoea, chest discomfort and palpitation
5. Anaphylactoid shock.

Delayed adverse reactions

1. Renal impairment
2. Nephrogenic systemic fibrosis (NSF)

Dose

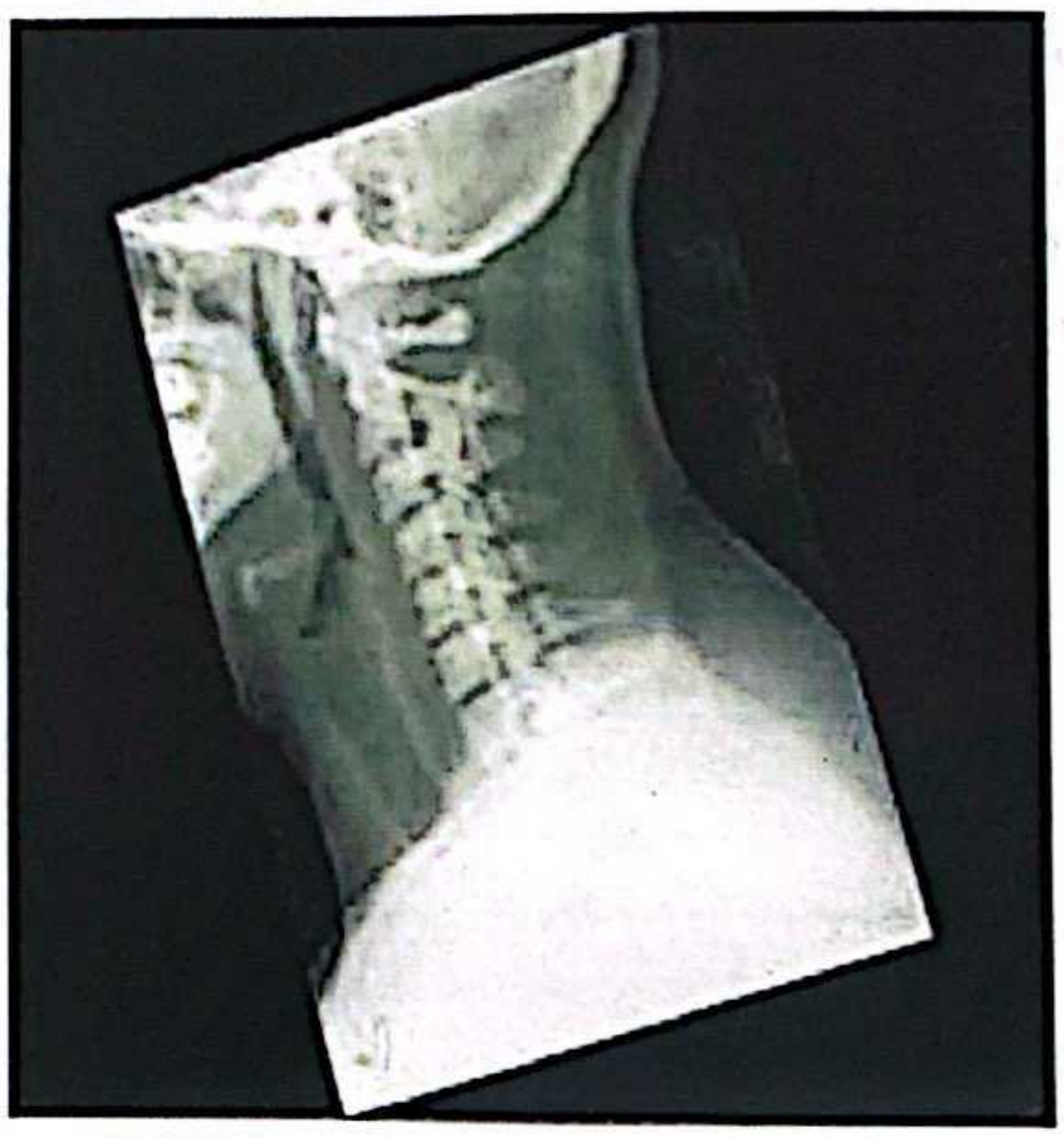
- For ECF gadolinium agents, usually 0.1 mmol kg body weight (e.g. 0.2 ml of Magnevist/kg); up to 0.2 mmol/kg when used in low-field magnets.
- 0.2 mL/ kg.
- For 60 Kg 12 mL total dose (60x0.2)

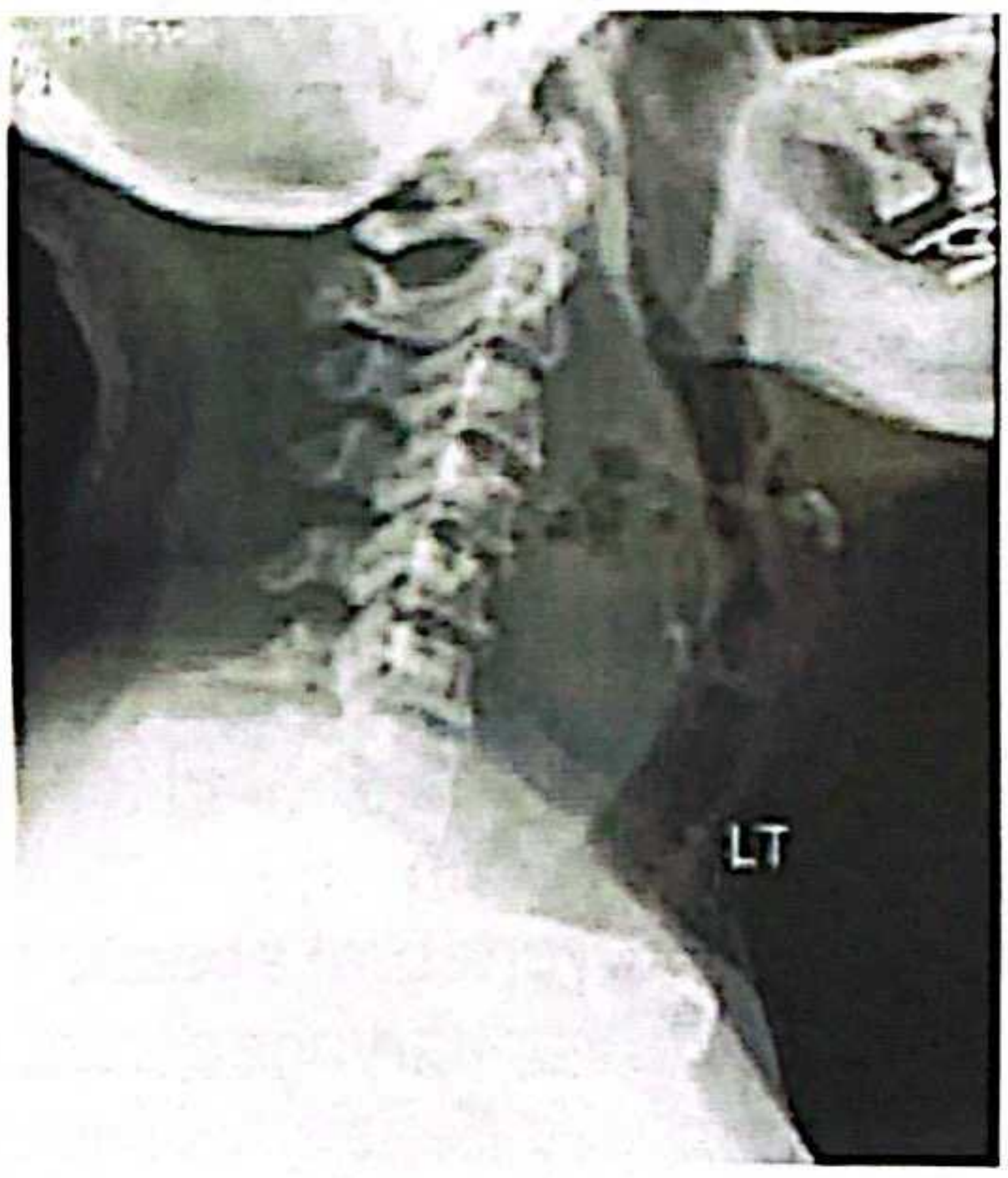
PreMedication for Already at-Risk Patient:
Known Previous Reaction:
Oral prednisolone Total 30mg orally 12 and 2 hours before contrast medium

- Tab PREDNISOLONE 5 mg
  10 tab 13 hours before the examination
- Tab PREDNISOLONE 5 mg
  10 tab 7 hours before the examination
- Tab PREDNISOLONE 5 mg
  10 tab 1 hours before the examination
- Tab Telfast 120 mg
  01 tab 1 hours before the examination

Q.18) Represented with neck pain. Not responding to analgesia. No history of trauma or heavy lifting. Midline tenderness.

(2015)





Identify: Xray Neck Soft Tissue Cervical Spine Levels Lateral View

Describe:

1. Reversal of normal cervical lordosis. Increased width of prevertebral tissues at the upper cervical spine.
2. Well corticated bony fragment below the anterior arch of C1 is presumably degenerative.
3. Marked widening of the pre-vertebral soft tissue between C2 and C7
4. Multiple gas foci within at the C3-C4 level.

Diagnosis: Retropharyngeal abscess

What next:

CT is excellent at evaluating the neck and is able to do so in a short time (much faster than an MRI) which is an important factor when imaging patients with potential narrowing of the airway.

Scans should be obtained with contrast to allow differentiation of fluid collections from phlegmonous thickening (retropharyngeal cellulitis).

MRI

MRI has superior contrast resolution than CT and is able to interrogate the retropharyngeal space with a number of imaging sequences including diffusion.

T1: central low to intermediate signal
T2: central high signal
T1 C+ (Gd): peripheral enhancement
DWI: increased values, indicative of restricted diffusion

Treatment:

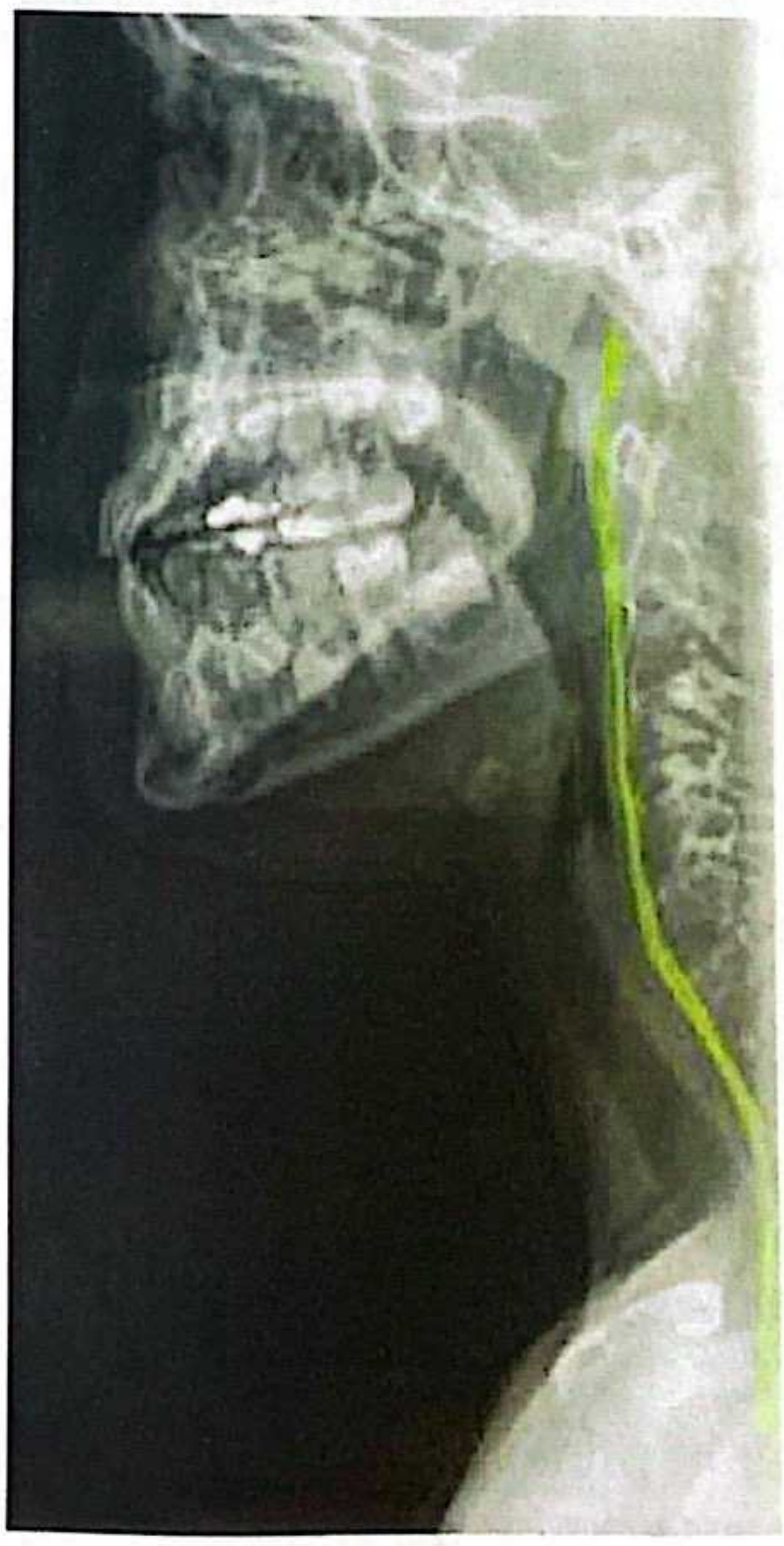
Treatment is similar in principle to that of other infected collections usually requiring both surgical drainage (usually performed via a transoral route) and intravenous antibiotics. In some instances antibiotics alone may suffice, when collections are small

Complications:

1. Posterior extension to pre-vertebral space, discitis osteomyelitis, epidural abscess
2. Lateral extension involving carotid artery (haemorrhage, pseudoaneurysm, thrombosis) and jugular vein (thrombosis)
3. Anterior compression and compromise of the airway
4. Inferior extension into the mediastinum resulting in mediastinitis
5. Systemic dissemination and development of sepsis
6. Grisel syndrome
7. Lemierre syndrome

Differential diagnosis:

1. Retropharyngeal cellulitis: i.e. Same pathology but no abscess formation
2. Prevertebral abscess: usually secondary to discitis osteomyelitis
3. Retropharyngeal haematoma 5
4. Blood density/intensity on ct/mri
5. Capps triad
6. Mass involving retropharyngeal space: e.g. Haemangioma, tumour
7. Retropharnygeal pseudothickening (especially in young children i.e. Short neck)
8. Excessive neck flexion



Danger space

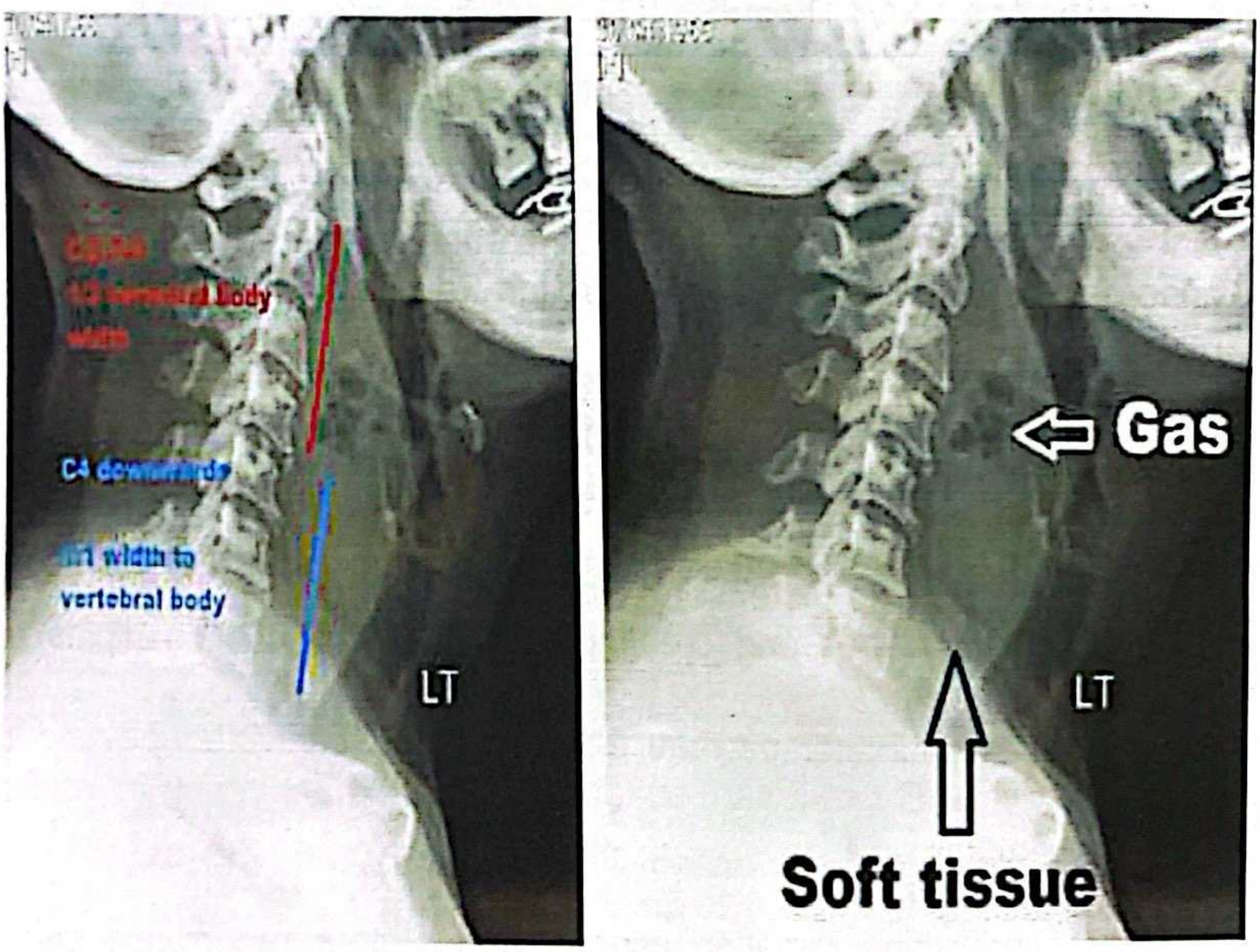
The danger space is a potential space located behind the true retropharyngeal space, which connects the deep cervical spaces to the mediastinum.

Boundaries

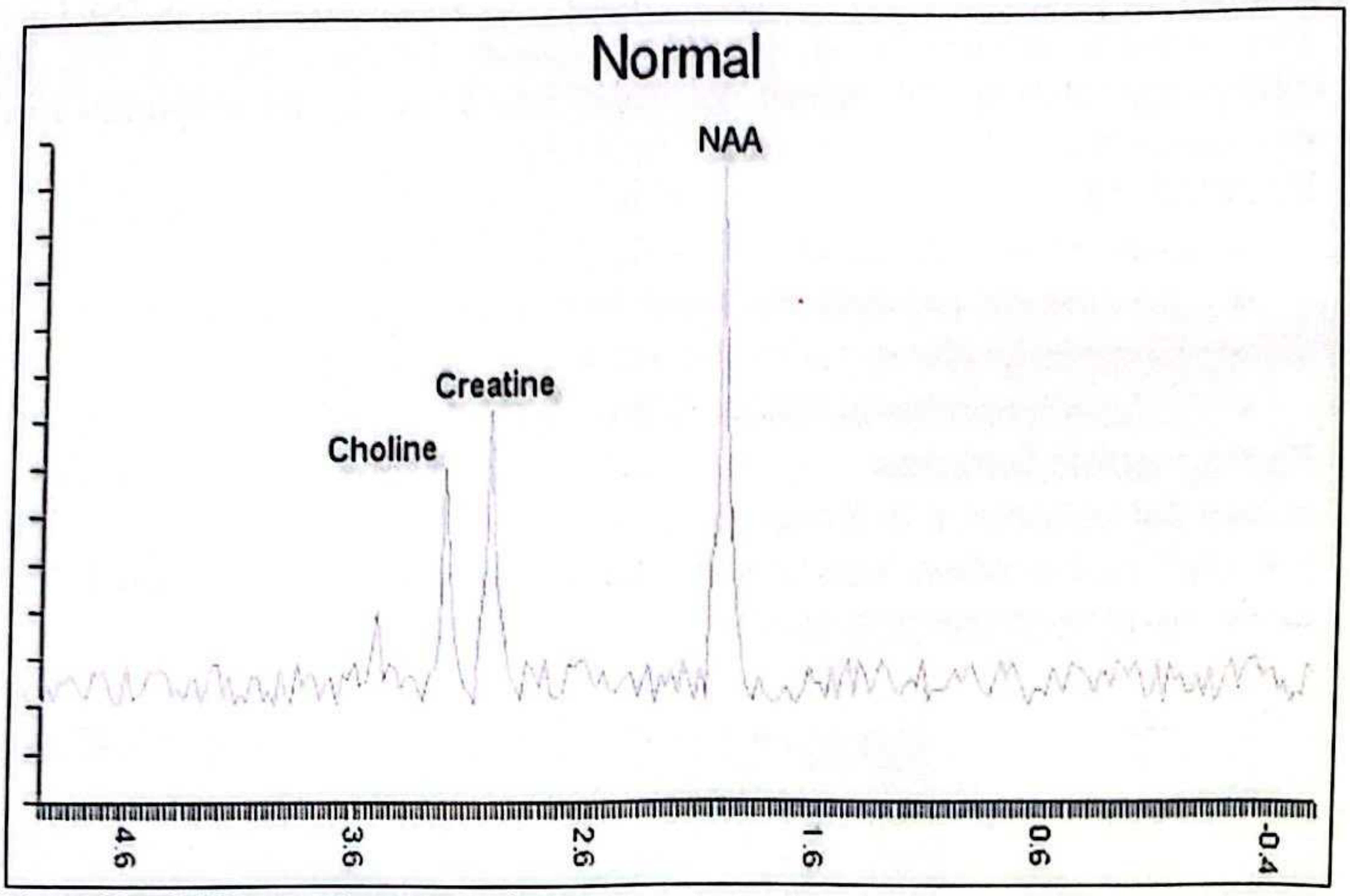
- anteriorly: alar fascia
- posteriorly: prevertebral layer of the deep cervical fascia
- superiorly: clivus
- inferiorly: posterior mediastinum at the level of the diaphragm

Radiographic features

In healthy patients, it is indistinguishable from the retropharyngeal space. It is only visible when distended by fluid or pus, below the level of T1-T6, since the retropharyngeal space variably ends at this level.


C2-C3
1/3 vertebral body
width
C4 downwards
1:1 width to
vertebral body
LT
Gas
LT
Soft tissue

Q.19) Identify: **(2015)**



Identify: MR spectroscopy image

Markers of necrosis: Lactate will increase as the brain switches to anaerobic metabolism. When infarction takes place then lipids are released, and peaks appear

PRES: Posterior reversible encephalopathy syndrome

Clinically isolated syndrome (CIS) is the first episode suggestive of demyelination. It can either be monofocal (single lesion) or multifocal

Glioma:

- MRS can help increase our ability to predict grade. As the grade increases, NAA and creatine decrease and choline, lipids and lactate increase.
- In the setting of gliomas, choline will be elevated beyond the margins of contrast enhancement in keeping with cellular infiltration.

Radiation effects:

- Distinguishing radiation change and tumour recurrence can be problematic.
- In recurrent tumour choline will be elevated
- In radiation change, NAA, choline and creatine will all be low.

Ischaemia and infarction:

- Lactate will increase as the brain switches to anaerobic metabolism.
- When infarction takes place then lipids are released and peaks appear.

Infection:

- As in all processes which destroy normal brain tissue, NAA is absent.
- Within bacterial abscess cavities, lactate, alanine, cytosolic acid and acetate are elevated/present.

Of note choline is low or absent in toxoplasmosis, whereas it is elevated in lymphoma, helping to distinguish the two.

White matter diseases:

- Progressive multifocal leukoencephalopathy (PML) may demonstrate elevated myo-inositol
- Canavan disease characteristically demonstrates elevated NAA

Hepatic encephalopathy

- Markedly reduced myo-inositol, and to a lesser degree choline.
- Glutamine is increased.

Mitochondrial disorders

Leigh syndrome: elevated choline, reduced NAA and occasionally elevated lactate

Mnemonic

My ChoCrNaaLa (think of a new chocolate energy bar or something)
My: Myo-inositol 3.5
Cho: Choline 3.2
Cr: Creatine 3.0
Naa: Naa 2.0
L: Lactate 1.3

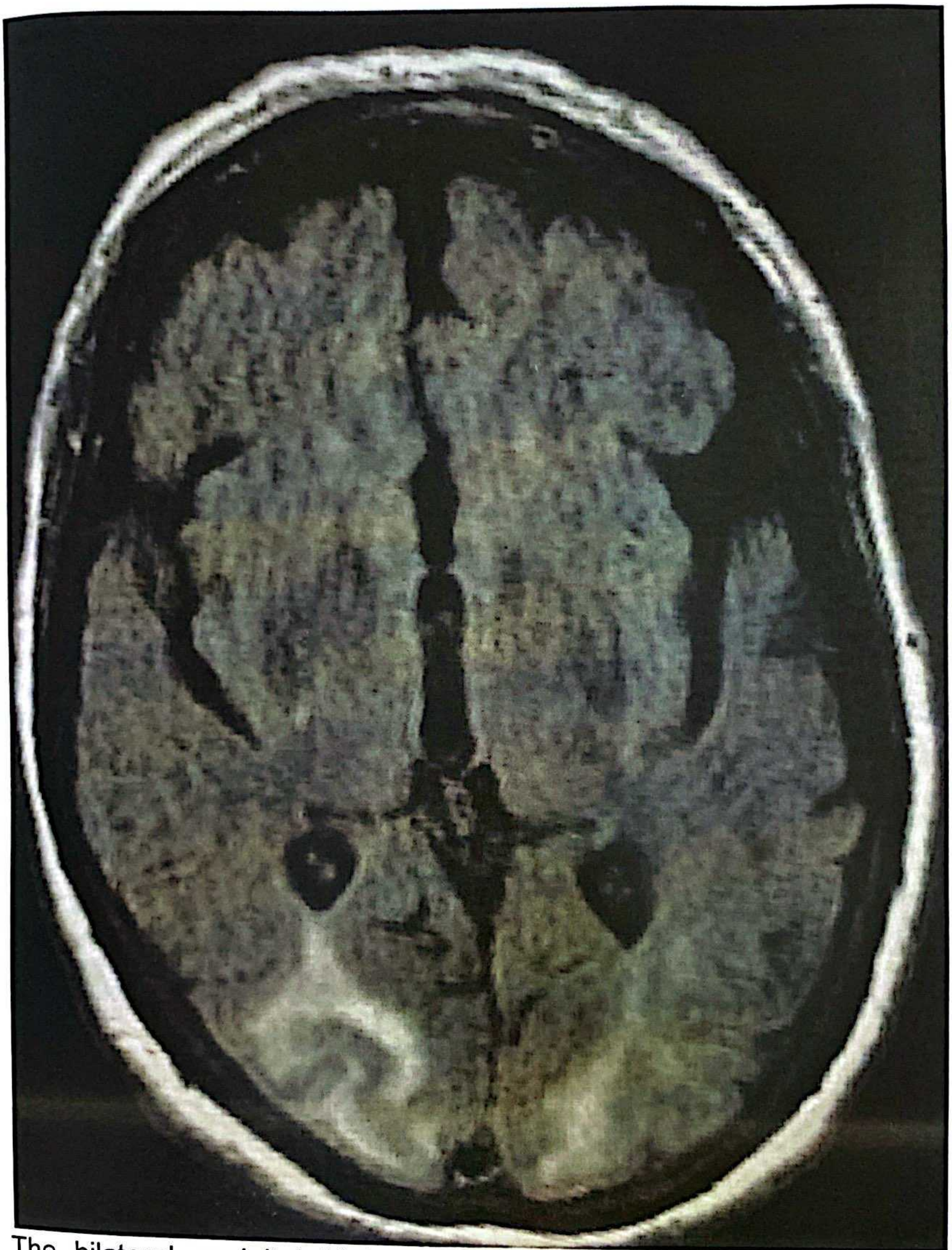
Hunter's angle is the line formed by the metabolites in MR spectroscopy.45°

Metabolite	Location ppm	Normal function	Increased
Lipids	0.9 & 1.3	Cell membrane component	Hypoxia, trauma, high grade neoplasia.
Lactate	1.3 TE=272 (upright) TE=136 (inverted)	Denotes anaerobic glycolysis	Hypoxia, stroke, necrosis, mitochondrial diseases, neoplasia, seizure
Alanine	1.5	Amino acid	Meningioma
Acetate	1.9	Anabolic precursor	Abscess , Neoplasia.

Metabolite	Location ppm	Normal function	Increased	Decreased
NAA	2	Nonspecific neuronal marker (Reference for chemical shift)	Canavan's disease	Neuronal loss, stroke, dementia, AD, hypoxia, neoplasia, abscess
Glutamate , glutamine, GABA	2.1- 2.4	Neurotransmitter	Hypoxia, HE	Hyponatremia
Succinate	2.4	Part of TCA cycle	Brain abscess	
Creatine	3.03	Cell energy marker (Reference for metabolite ratio)	Trauma, hyperosmolar state	Stroke, hypoxia, neoplasia

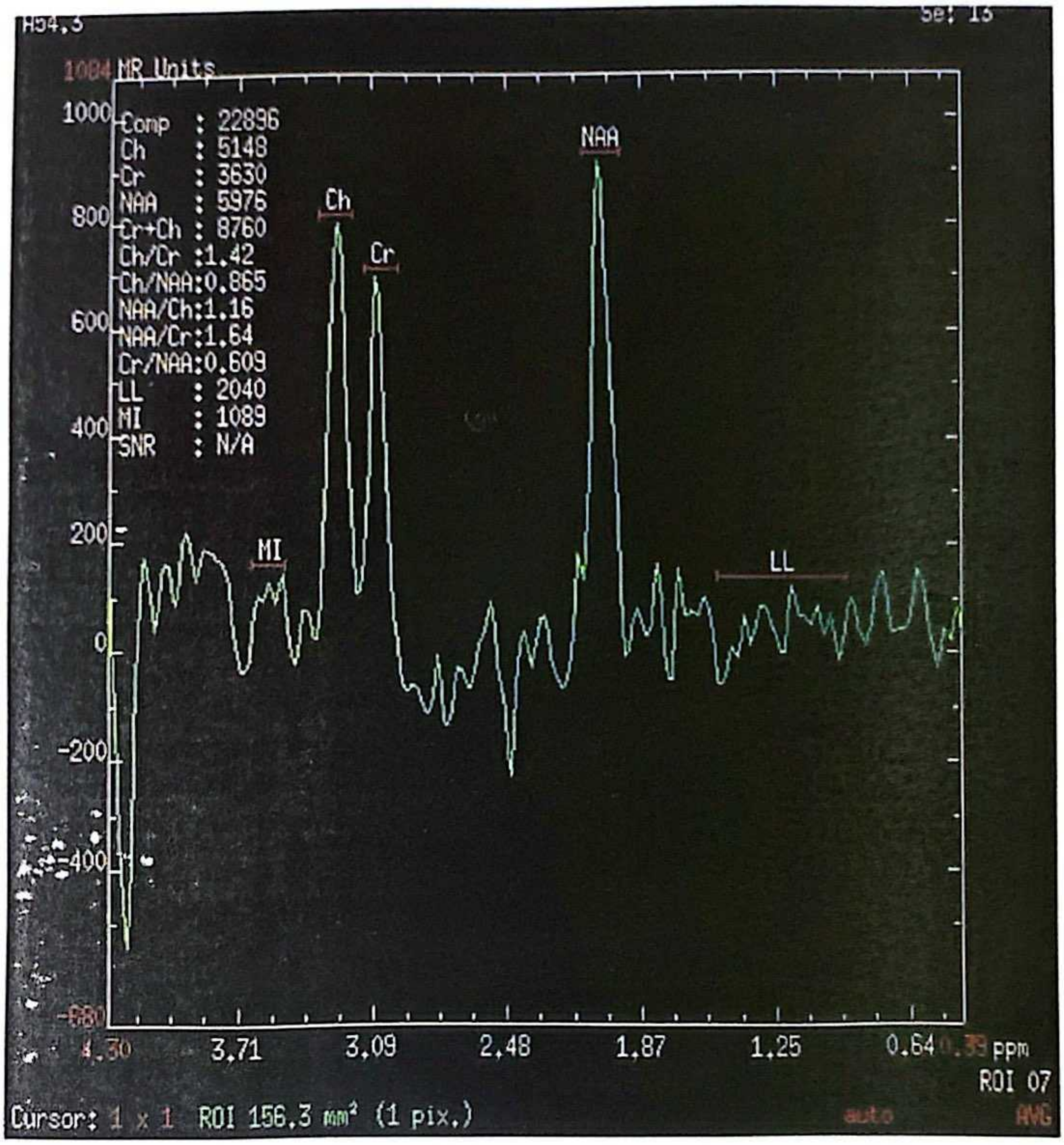
Metabolite	Location ppm	Normal function	Increased	Decreased
Choline	3.2	Marker of cell memb turnover	Neoplasia, demyelination (MS)	Hypomyelination
Myoinositol	3.5 & 4	Astrocyte marker	AD Demyelinating diseases	

(2013)



The bilateral occipital high signal on FLAIR, consistent with PRES. Followup scan two weeks later, after blood pressure control and resolution of symptoms demonstrated resolution of radiological findings. Clinically isolated syndrome (CIS) is the first episode suggestive of demyelination. It can either be monofocal (single lesion) or multifocal

(2014)



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Cr     : 3630
NAA    : 5976
Cr+Ch  : 8760
Ch/Cr  :1.42
Ch/NAA:0.865
NAA/Ch:1.16
NAA/Cr:1.64
Cr/NAA:0.609
LL     : 2040
MI     : 1089
SNR    : N/A
```

H54.3
Se: 13
1004 MR Units
1000
800
600
400
200
0
-200
-400
NAA
Ch
Cr
MI
LL
4.30
3,71
3,09
2,48
1,87
1,25
0,64
0.39 ppm
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AVG

MR spectroscopy of the right temporal lesion shows: Skull base osteomyelitis and temporal lobe abscess

significant elevation of the lipid / lactate peaks; predominantly within the central portion of the lesion as well as within the enhancing rim.

significant depression of the neural markers; N-acetyl aspartate (NAA) and creatine (Cr) as well as depression of the choline (Cho).

Q.20) What is the dose and rate of contrast used in performing aortogram with pigtail catheter.

(2014)

ASCENDING AORTOGRAPHY

Echocardiography, multislice CT, and MRI are preferable initial imaging modalities for assessment of the ascending aorta.

Indications

1. Aortic aneurysm, trauma or dissection
2. Atheroma at the origin of the major vessels
3. Aortic regurgitation (echocardiography is more sensitive and less invasive if available)
4. Congenital heart disease – particularly the demonstration of congenital or iatrogenic aorto-pulmonary shunts and coarctation
5. As a preliminary to endovascular intervention, e.g. aneurysm repair.

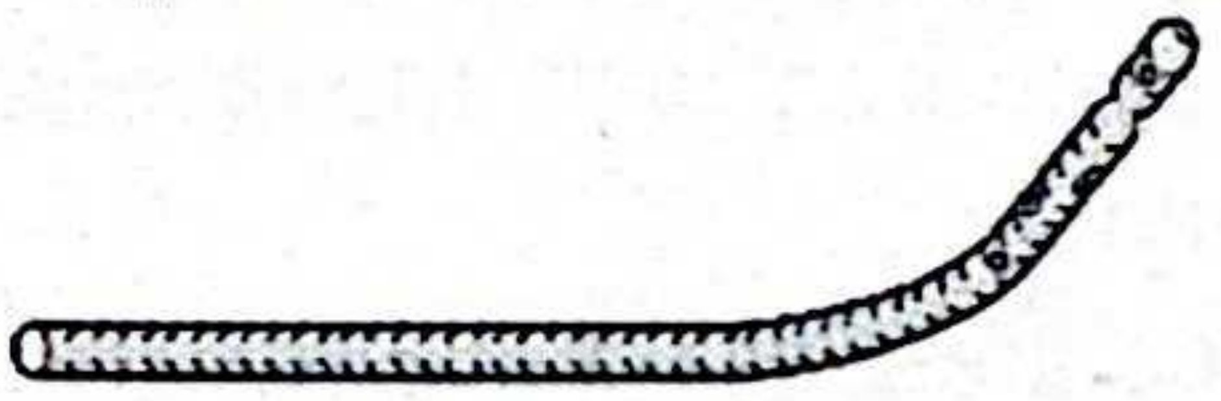
Contrast medium

Low osmolar contrast material (LOCM) 370, 0.75ml/kg (max. 40ml)

Rate: Inject at 18–20ml/s

Equipment

1. Digital fluoroscopy unit with C-arm capable of 20–30 frames/s
2. Pump injector
3. Catheter:
   - Pigtail
   - Gensini



Gensini catheter. Note tapered end. End holes: 1 Side holes: 6.

Technique

1. The catheter is introduced using the Seldinger technique via the femoral artery, and its tip sited 1-3cm above the aortic valve.
2. The patient is positioned 45 RPO to open out the aortic arch, and to show the aortic valve and the left ventricle to best advantage.
3. A test injection is performed to ensure that:

a. the catheter is correctly placed in relation to the aortic valve

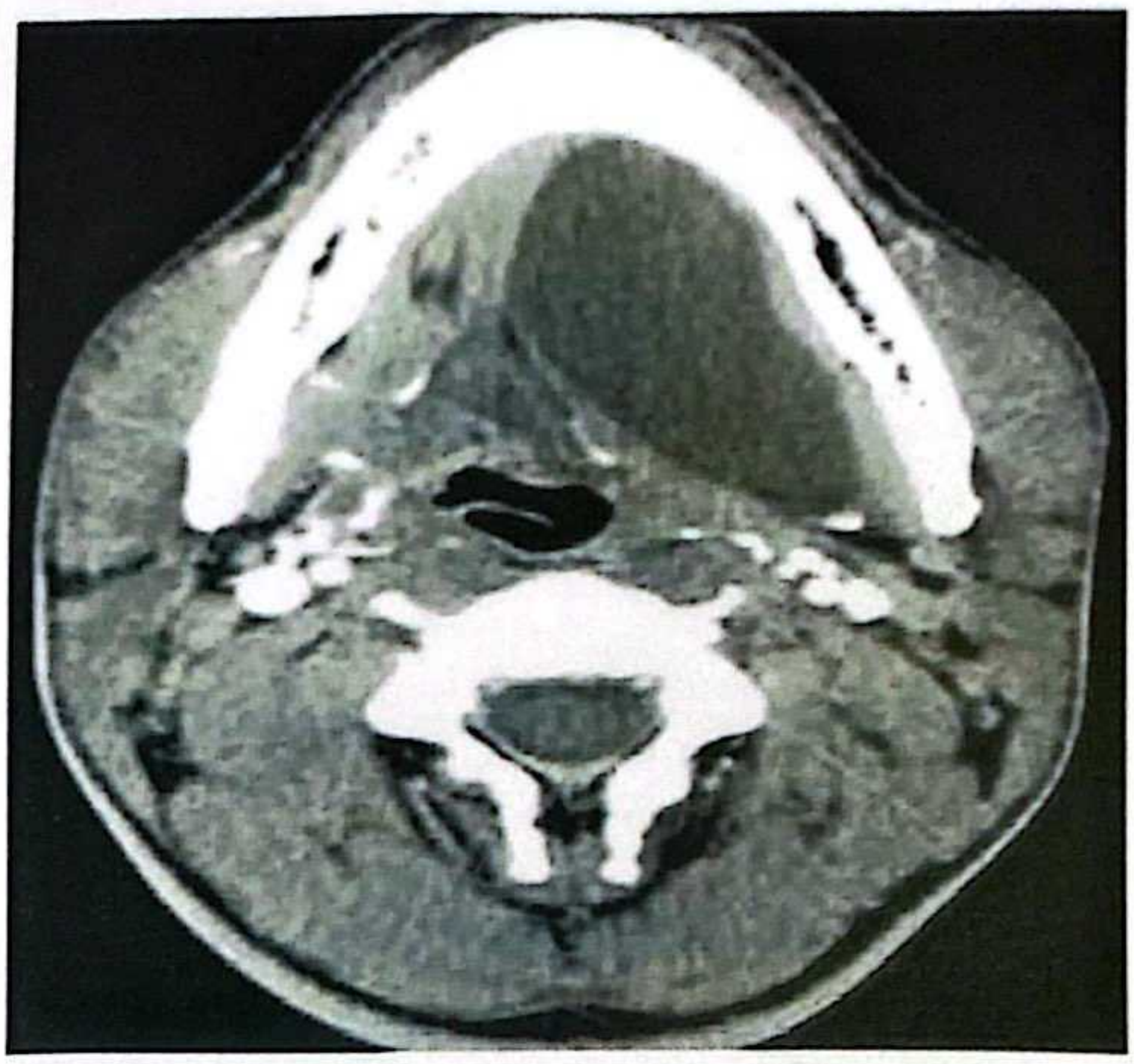
b. the catheter tip is not in a coronary artery.

Films:

20–30 frames/sec

50ml of 350mgI/ml at a rate of 12–15ml/s is suitable for a catheter aortogram.

Q.21) Mass in the floor of mouth and bluish tinge neck (2014)



Identify: Contrast enhanced CT floor of mouth axial image

Describe: Well-defined oval hypodense fluid density lesion in the left half of floor of mouth with mass effect on the adjacent left valeculae and hypopharynx.

No post contrast enhancement. Absence of peripheral enhancement.

Diagnosis: Plunging ranula

What next: MRI

T1: low signal

T2: high signal

T1 C+ (Gd): the wall may demonstrate some enhancement (best seen with fat saturation)

Treatment:

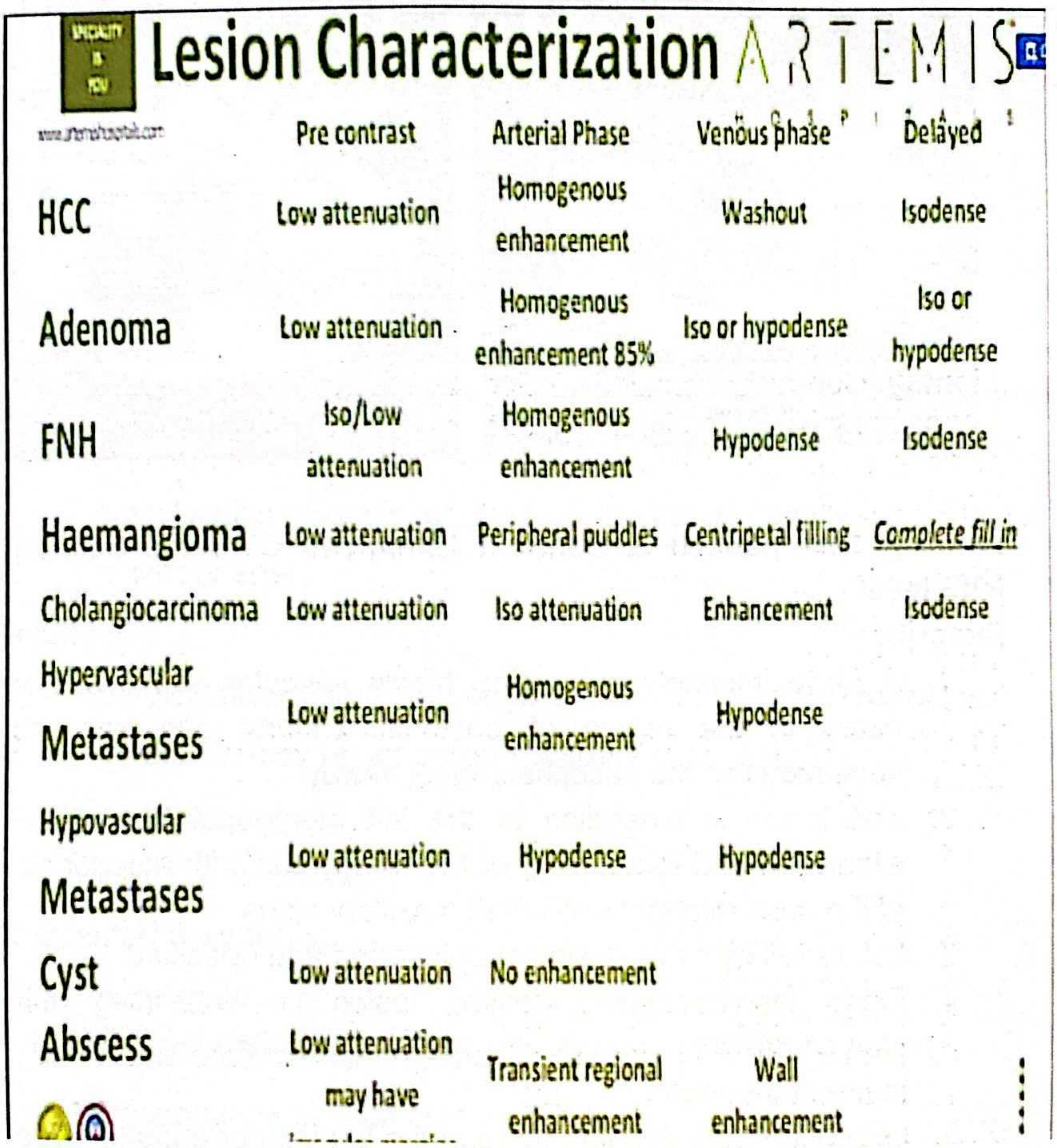
1. Surgical resection
2. Incision and drainage
3. Marsupialization
4. Excision of the lesion in the neck
5. Excision of the lesion in the neck and sublingual gland
6. Intraoral excision of the sublingual gland and drainage of the cyst
7. Sclerotherapy with OK-432

Differential diagnosis

1. Dermoid/epidermoid cyst
2. Cystic hygroma
3. Cervical abscess
4. Thyroglossal duct cyst
5. 2nd branchial cleft cyst
6. Cystic/necrotic lymph node

Q.22) When do you perform the following phases for liver dynamic study? (2014)

Arterial phase
Venous phase
Delayed phase

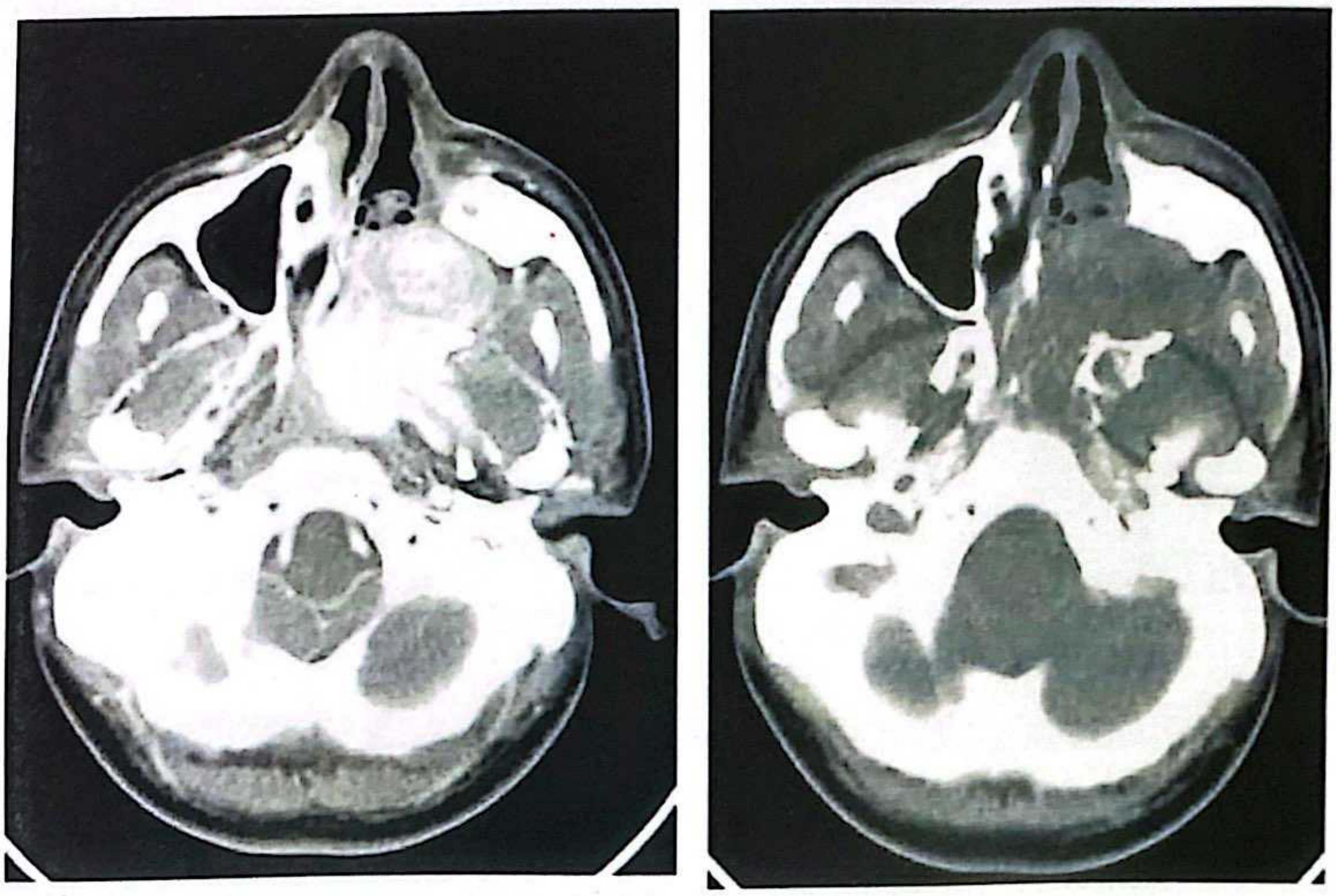


Lesion Characterization ARTEMIS

	Pre contrast	Arterial Phase	Venous phase	Delayed
HCC	Low attenuation	Homogenous enhancement	Washout	Isodense
Adenoma	Low attenuation	Homogenous enhancement 85%	Iso or hypodense	Iso or hypodense
FNH	Iso/Low attenuation	Homogenous enhancement	Hypodense	Isodense
Haemangioma	Low attenuation	Peripheral puddles	Centripetal filling	Complete fill in
Cholangiocarcinoma	Low attenuation	Iso attenuation	Enhancement	Isodense
Hypervascular Metastases	Low attenuation	Homogenous enhancement	Hypodense	
Hypovascular Metastases	Low attenuation	Hypodense	Hypodense	
Cyst	Low attenuation	No enhancement		
Abscess	Low attenuation may have	Transient regional enhancement	Wall enhancement	

Q.23) **(2014)**

Epistaxis-16 years-Male



Identify: Unenhanced & Contrast Enhanced CT Axial Sections at PNS level

Describe:

1. A large intensely enhancing highly vascular soft tissue lesion noted in the region of posterior choana and nasopharynx compromising the nasopharyngeal airway.
2. The lesion is extending to the left pterygopalatine fossa with expansion and remodeling of the fossa, and with anterior bowing of the posterolateral wall of left maxillary sinus.
3. Left maxillary sinus is almost obliterated and opacified.
4. From pterygopalatine fossa, lesion is extending through pterygomaxillary fissure to the left infratemporal fossa and masticator space.
5. Lesion is also extending through the left inferior orbital fissure into the orbit with expansion of the fissure.
6. There is intracranial extension into the left middle cranial fossa through the widened superior orbital fissure.
7. Left cavernous sinus and temporal lobe are compressed, thereby causing engorgement left superior ophthalmic vein.

8. Anteriorly the lesion is extending to the left nasal cavity with expansion remodeling of the bony nasal septum.

Diagnosis: Juvenile nasopharyngeal angiofibroma

What next:

MRI: is excellent at evaluating tumour extension into the orbit and intracranial compartments.

- T1: intermediate signal
- T2: heterogeneous signal: flow voids appear dark
- T1 C+ (Gd): shows prominent enhancement
- The presence of prominent flow voids lead to a salt and pepper appearance on most sequences and are characteristic.

DSA:

- Angiography, although not essential, is often useful in both defining the feeding vessels as well as in preoperative embolisation. Supply of these tumours is usually via: Internal maxillary artery

Treatment:

- Surgical resection (either open or increasingly endoscopic)
- Irradiation may be an option if surgery is not possible

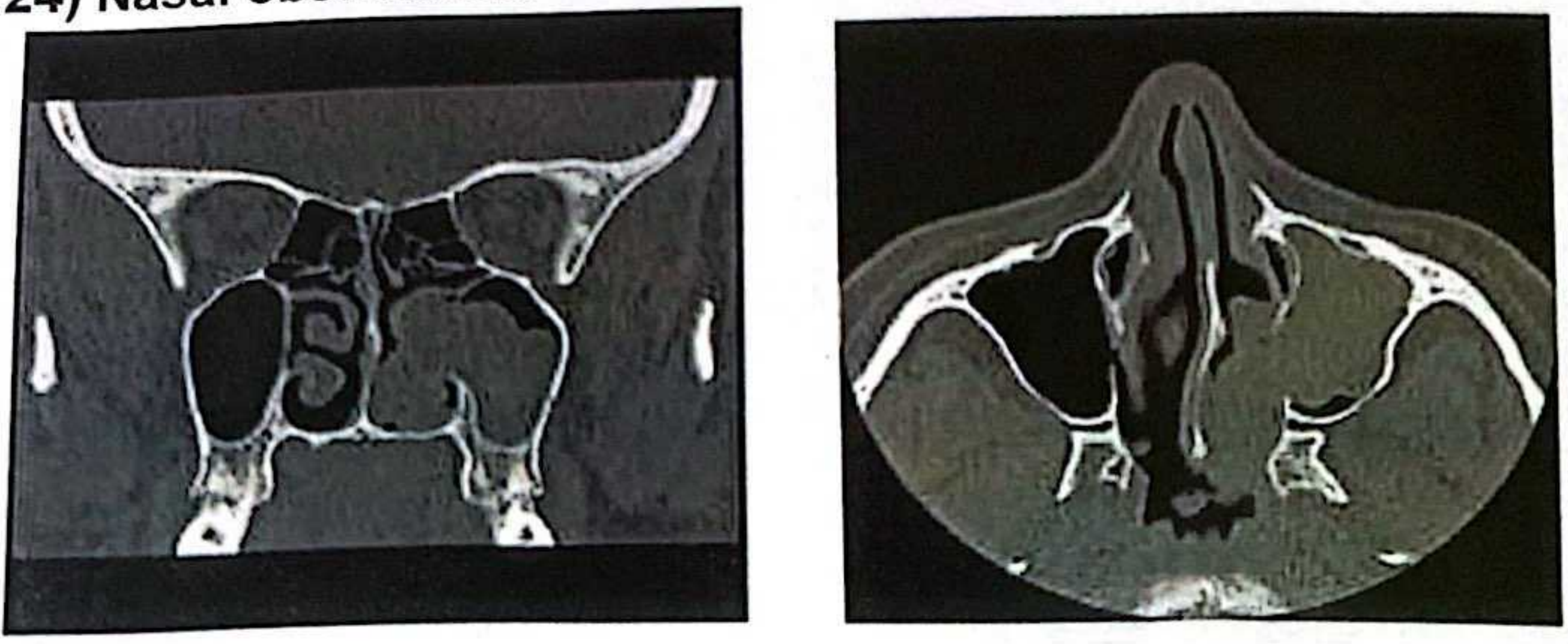
Complications:

- Acute haemorrhage

Differential diagnosis:

1. Angiomatous polyp
2. Rhabdomyosarcoma (head and neck)
3. Nasopharyngeal carcinoma (NPC)
4. Nasopharyngeal teratoma
5. Lymphangioma: no contrast enhancement
6. Encephalocoele: no contrast enhancement
7. Esthesioneuroblastoma

Q.24) Nasal obstruction. **(2015)**



Identify: Unenhanced CT Axial and Coronal Section Images of Paranasal Sinuses

Describe:

1. A well-defined mass with mucin density is seen arising from the maxillary sinus
2. It is causing widening of the maxillary ostium and extending into the nasopharynx
3. There is no associated bony destruction but rather smooth enlargement of the sinus

Diagnosis: Antrochoanal polyp

What next:

MRI

- T1: intermediate to low signal
- T2
  high homogeneous T2 signal
  Signal may vary if they are chronic and/or if fungal infection is present
- T1 C+ (Gd): peripheral enhancement is seen on post-contrast images

Treatment:

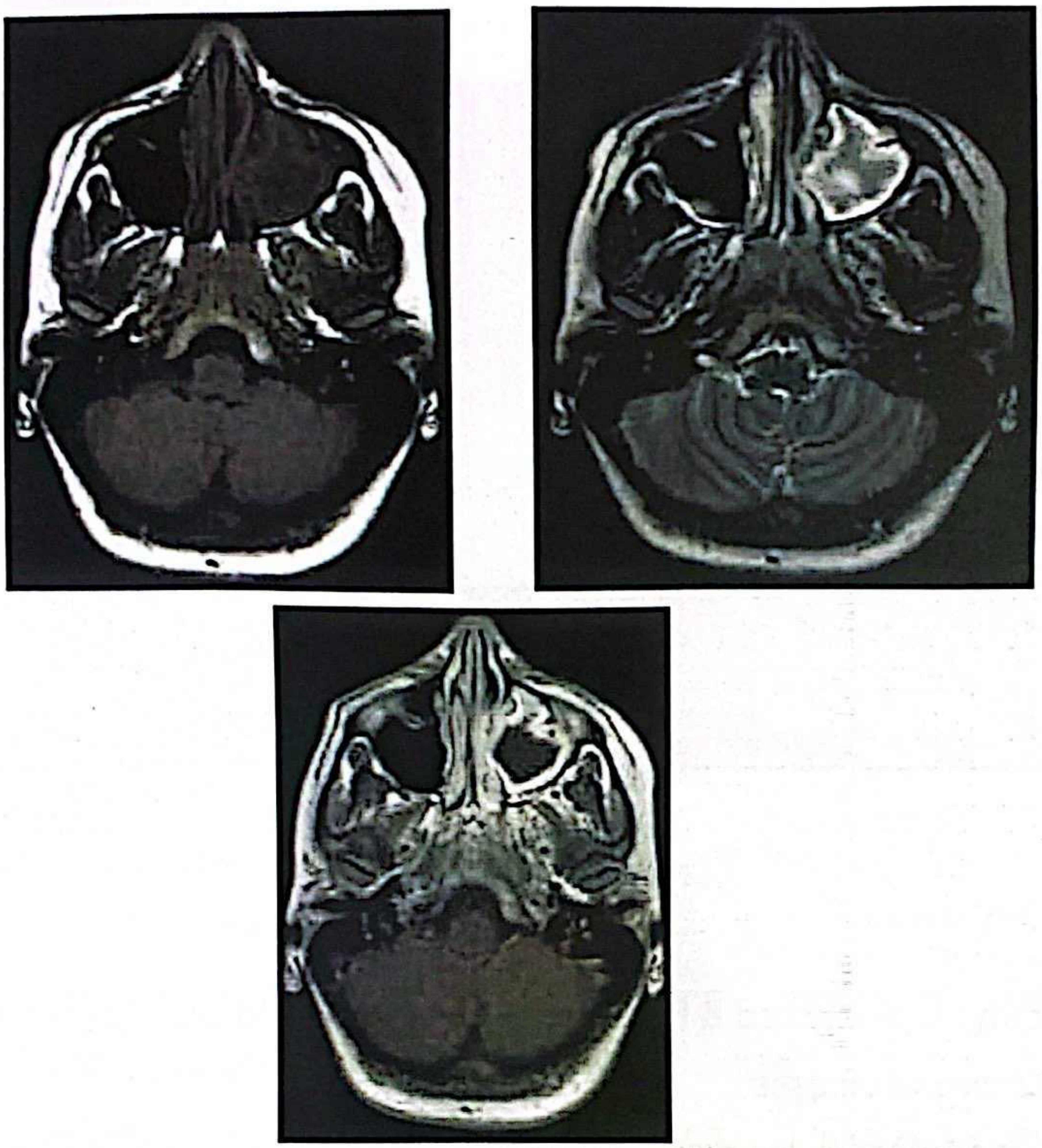
Classic treatment is intranasal snare polypectomy.

Differential diagnosis:

1. Hypertrophied turbinate
2. Inverted papilloma
3. Esthesioneuroblastoma
4. Juvenile nasopharyngeal angiofibroma (JNA)
5. Nasoethmoidal encephalocele
6. Maxillary sinus mucocele
7. Acute sinusitis with oedematous mucosa prolapsing from maxillary antrum
8. Sinonasal organised haematoma

Q.25) Nasal discharge; headache; case of recurrent sinusitis.

(2013)



Identify: Unenhanced and Enhanced T1W1 and T2W1 MRI Axial section Images through Paranasal Sinuses

Describe:

There is complete opacification of the left maxillary antrum.

The content is isointense on T1, intermediate signal centrally and high signal peripherally on T2 and demonstrates only peripheral enhancement.

The sinus is expanded slightly.

Diagnosis: Mucocoele of the left maxillary antrum

What next:

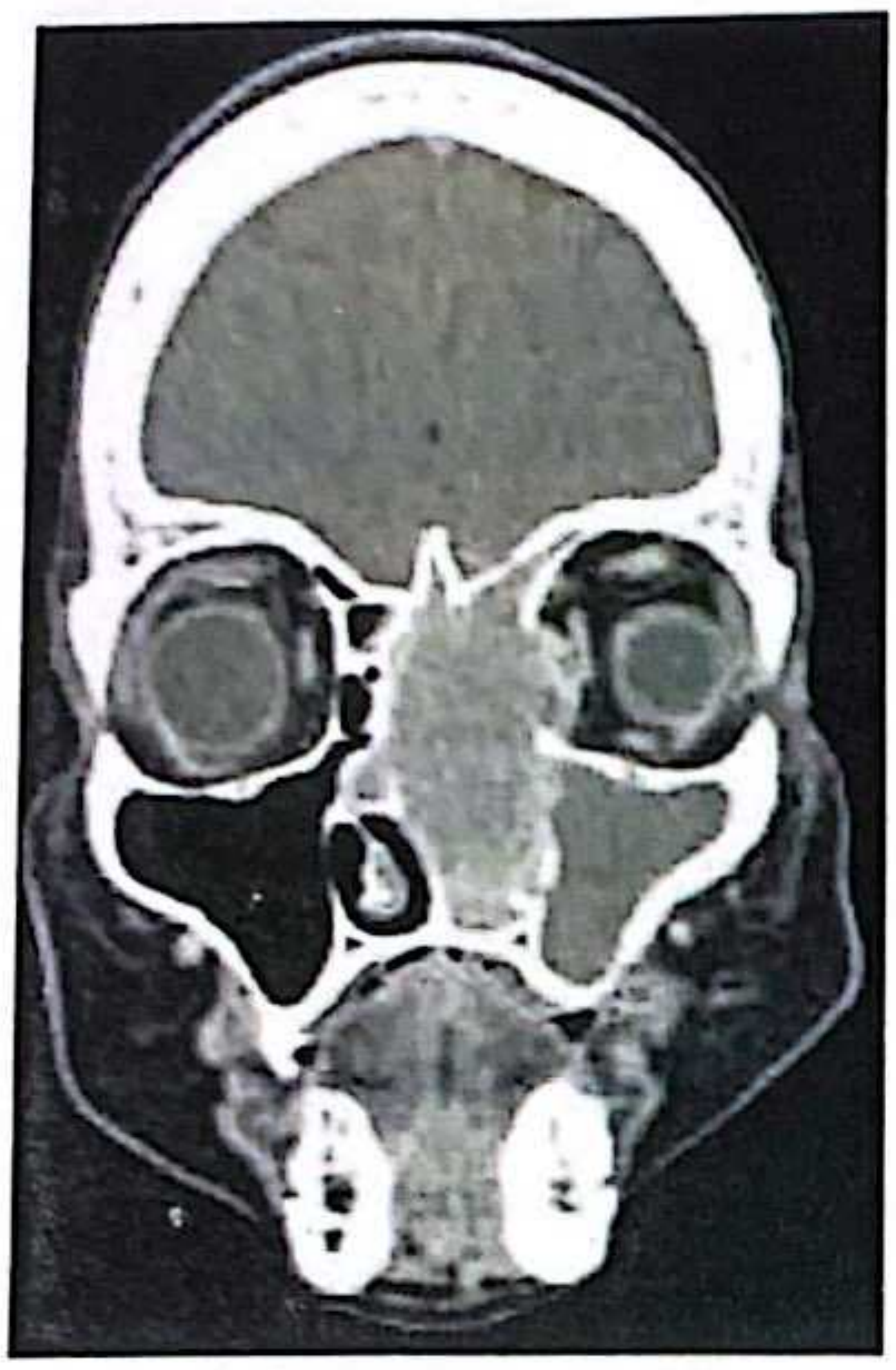
1. Drainage and marsupialisation of an affected sinus.
2. If large bony defects are present, reconstructive surgery

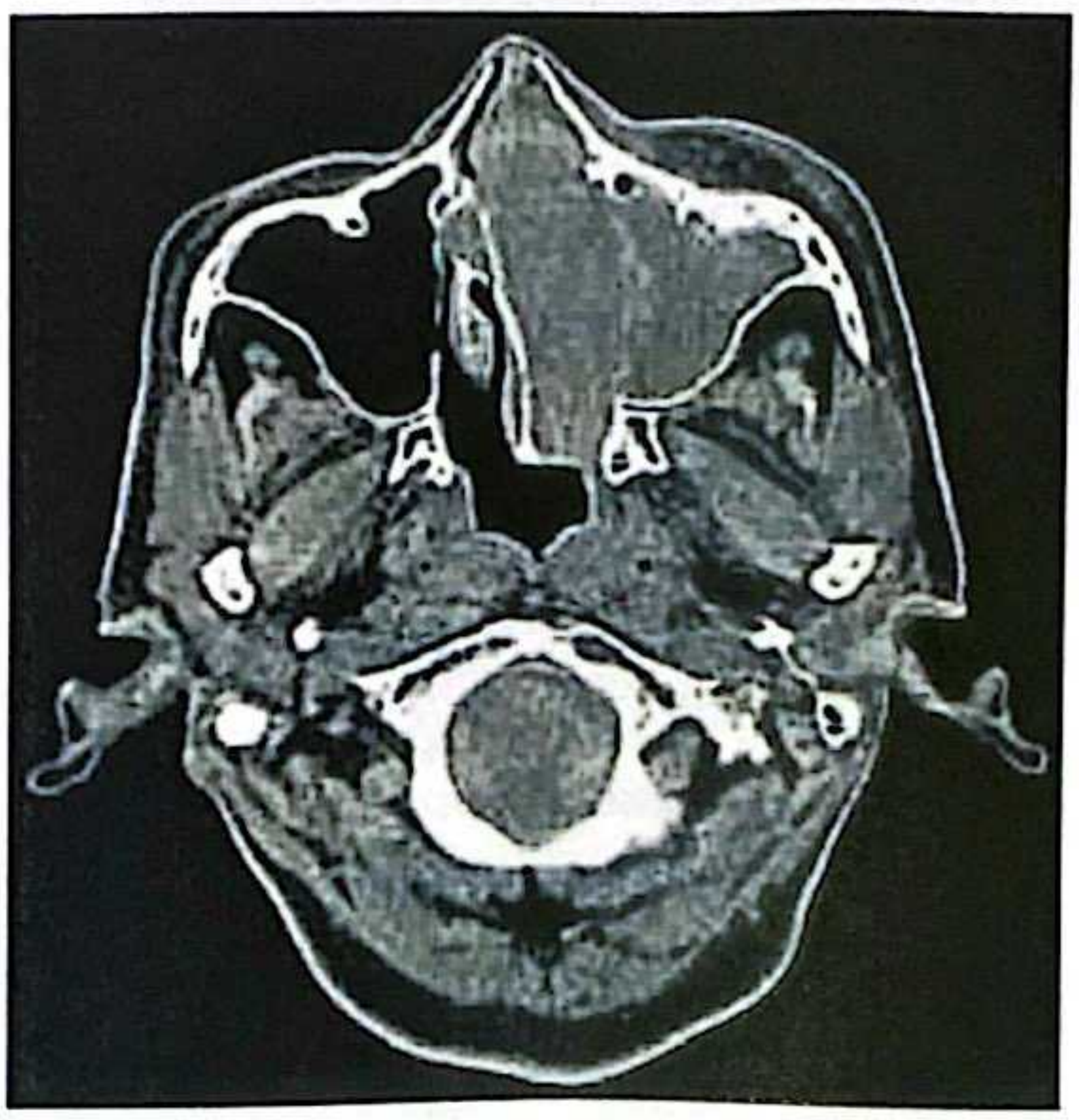
Differential Diagnosis:

1. Inverted papilloma or sinonasal carcinoma
2. Mucus retention cyst
3. Antrochoanal polyp
4. Acute sinusitis

Q.26) Nasal discharge and block

(2014)





Identify: Unenhanced & Enhanced CT Axial and Coronal Section Images of Paranasal Sinuses

Describe: Enhancing mass in the left side nasal cavity with destruction of the bony nasal septum, left lateral nasal wall, erosion of lamina papyracea and the base of skull along the anterior cranial fossa with secondary sinusitis in the maxillary sinus, left frontal and the sphenoid sinus.

Diagnosis: Inverted papilloma with secondary sinusitis

What next:

MRI: often demonstrates a distinctive appearance, referred to as convoluted cerebriform pattern, seen on both T2 and contrast enhanced T1 weighted images.

T1: isointense to muscle

T2

- generally hyperintense to muscle
- alternating hypointense lines

T1 C+ (Gd)

- heterogeneous enhancement
- alternating hypointense lines

DSA - angiography

- Angiography has no significant role to play in the diagnosis or assessment of inverted papillomas. If performed these tumours are mostly avascular.

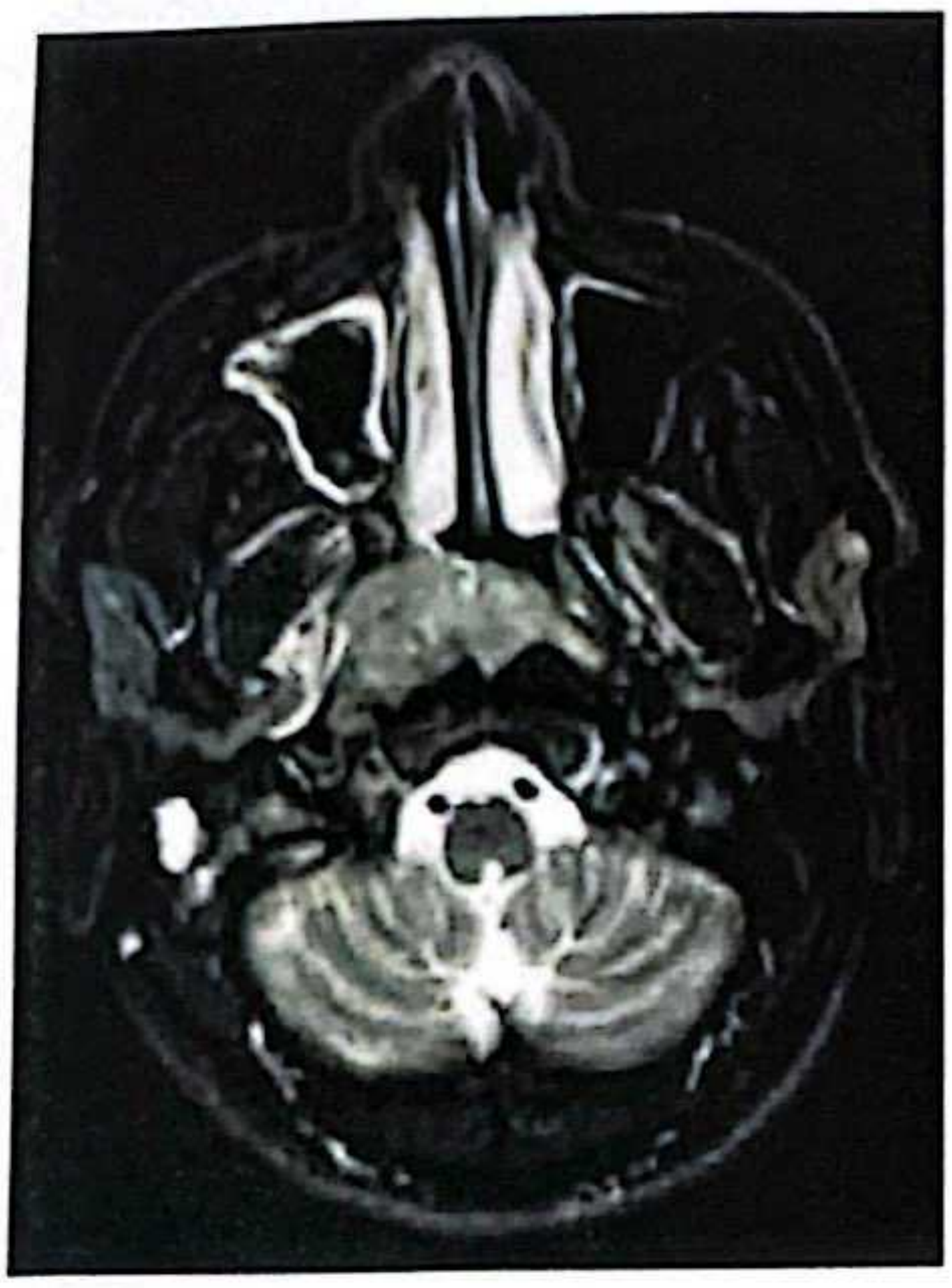
Treatment:

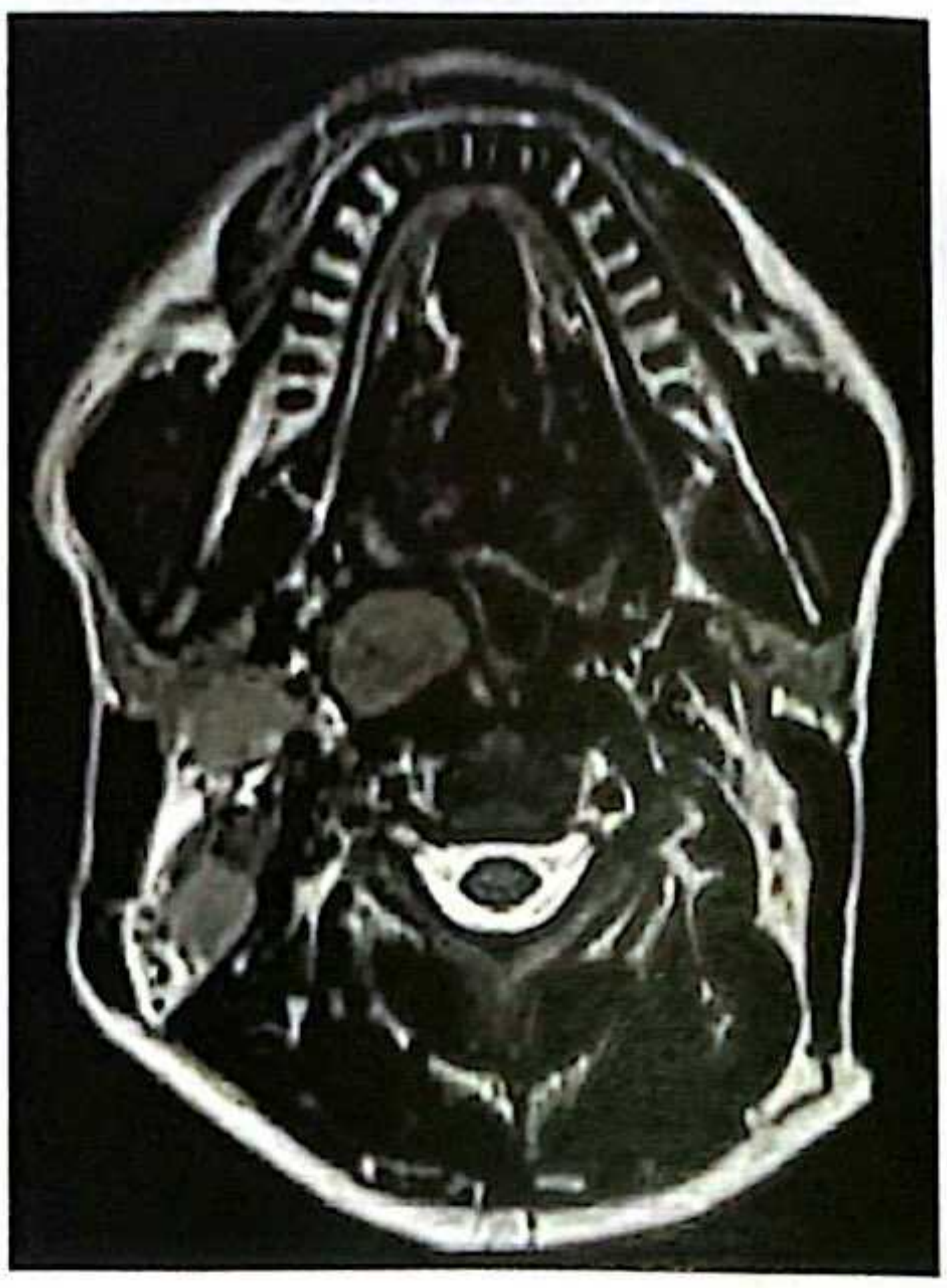
1. Resection en bloc with the lateral nasal wall (medial maxillectomy) via an external incision
2. Advanced endoscopic Resection

Differential diagnosis

1. Sinonasal carcinoma
2. Antrochoanal polyp: non-enhancing, peripheral mucosal enhancement may be present
3. Inflammatory polyp: non-enhancing, peripheral mucosal enhancement may be present
4. Juvenile nasopharyngeal angiofibroma (JNA)
5. Olfactory neuroblastoma
6. Paranasal sinus mucocoele

Q.27) **One-year history of difficulty breathing, multiple right ear infections and growing lump at the right side of neck.**

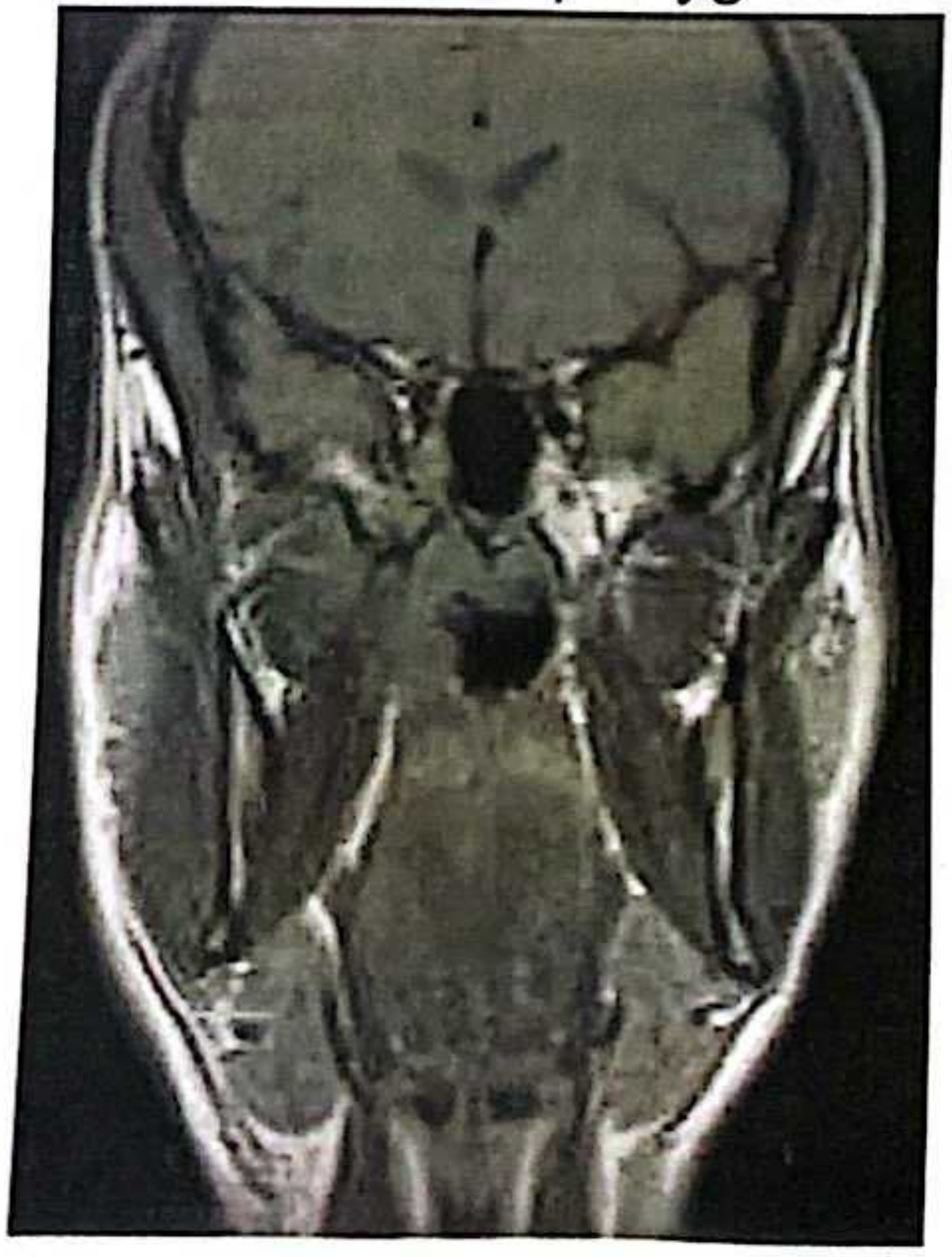


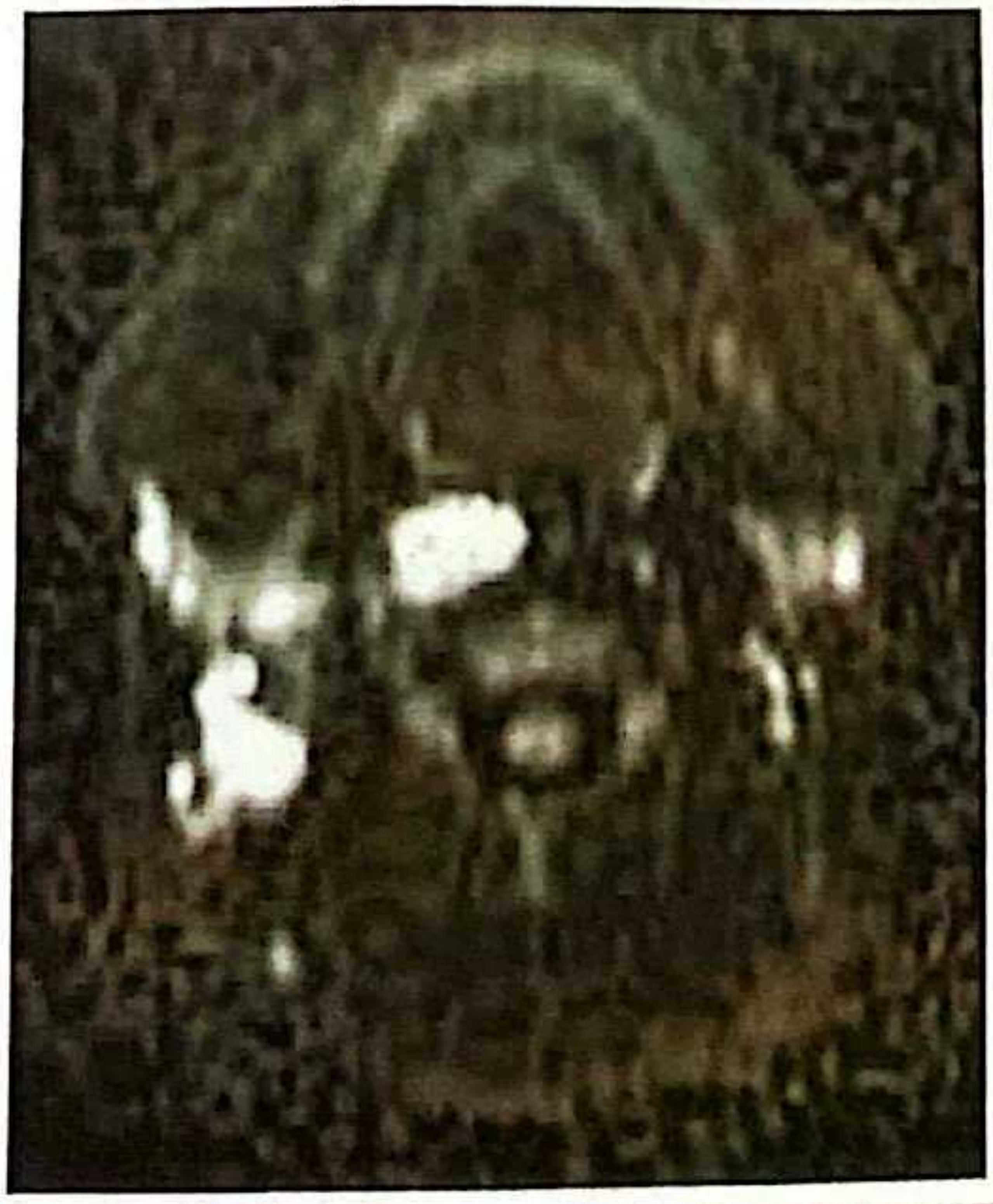


Identify: Unenhanced and Enhanced T1W1 and T2W1 MRI Axial & Coronal section Images

Describe:

1. Irregular asymmetrical soft tissue mass is seen involving the right nasopharyngeal region obliterating both fossae of Rosenmuller.
2. It is seen more sizable at the right aspect eliciting intermediate T1/T2 signal with avid homogeneous contrast uptake.
3. Anteriorly and superiorly It is seen reaching the right pterygoid plates that appear more sclerotic associated with altered marrow signal at the right aspect of the clivus showing postcontrast enhancement and enhancement of the most medial part of the related medial pterygoid muscle. Laterally It is seen encroaching





a-pharyngeal space.

4. Inferiorly it is seen merging with sizable right sided retropharyngeal pathologically enlarged lymph node and seen encroaching upon the related air way.
5. Posteriorly it is seen inseparable from the longus colli muscle at the right side.
6. The thin enhancing sheet is seen extending from the right aspect of the mass through slightly widened right foramen ovale (perineural spread along the mandibular division of the right trigeminal nerve).
7. Multiple metastatic pathologically enlarged right cervical lymph nodes.
8. Right side oto-mastoiditis is noted.

Diagnosis: Nasopharyngeal carcinoma with perineural spread

What next: Diagnostic biopsy.

CT

- Nasopharyngeal carcinomas appear as soft tissue masses most commonly centred at the fossa of Rosenmüller.
- Careful assessment of cervical lymph nodes is essential due to the high rate of nodal involvement at the time of diagnosis.

F-18 FDG-PET is highly sensitive for nodal metastases and is the modality of choice to detect recurrence.

Treatment:

1. External beam radiotherapy
2. Chemotherapy
3. Surgery in radiation-resistant tumours and in local recurrence.

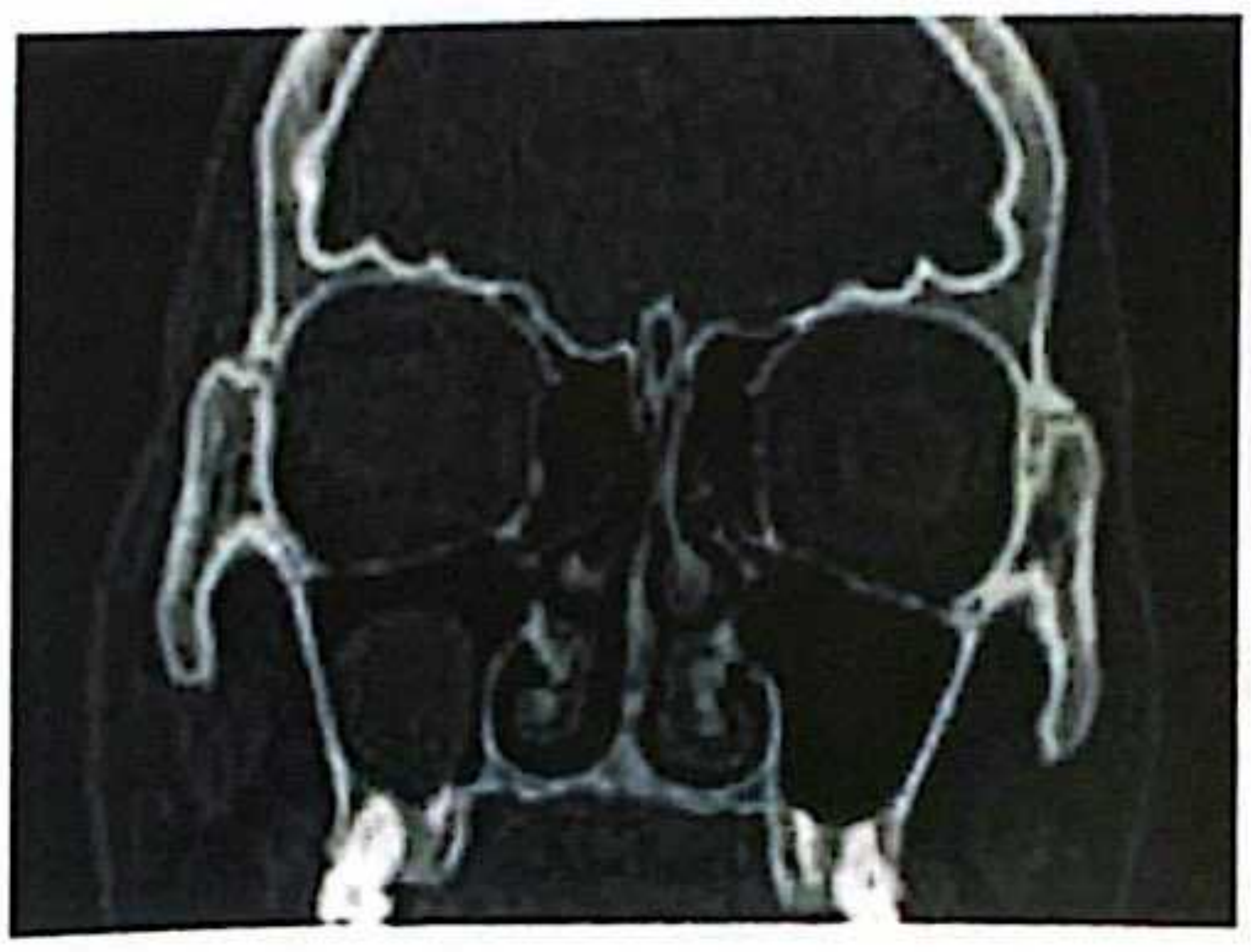
Complications:

A potential complication of radiotherapy is radiation necrosis of the temporal lobes, as well as cranial nerve dysfunction, and atrophy and fibrosis of the muscles of mastication and salivary glands

Differential diagnosis:

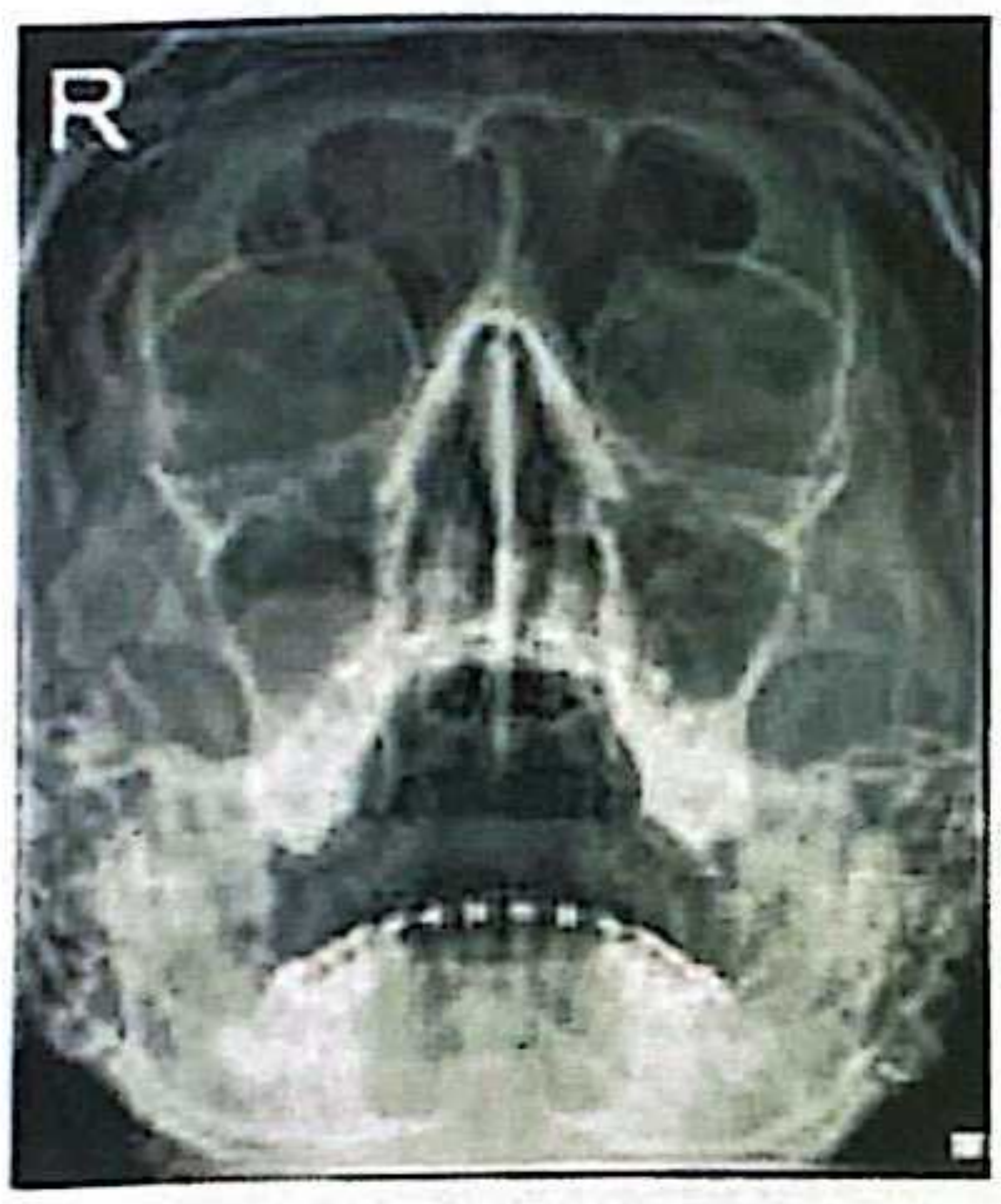
1. Prominent but normal adenoidal tissue
2. Nasopharyngeal lymphoma
3. Metastases to nasopharyngeal region

Q.28) Nasal problems



Mucous retention cyst of the right maxillary sinus.

Coronal Bone Window



Opacification of the right maxillary sinus.

Plain radiograph

On radiographs, they are radiopaque, dome-shaped structures with a rounded edge, located on the floor of the maxillary sinus.

CT/MRI

Similar to radiographs, retention cysts are seen on CT/MRI as rounded dome-shaped lesions usually situated on the maxillary sinus floor. They are of low attenuation on CT where they cannot be differentiated from a small polyp.

On MRI they are usually T1 and T2 hyperintense as opposed to polyps that tend to be of low T1 signal.

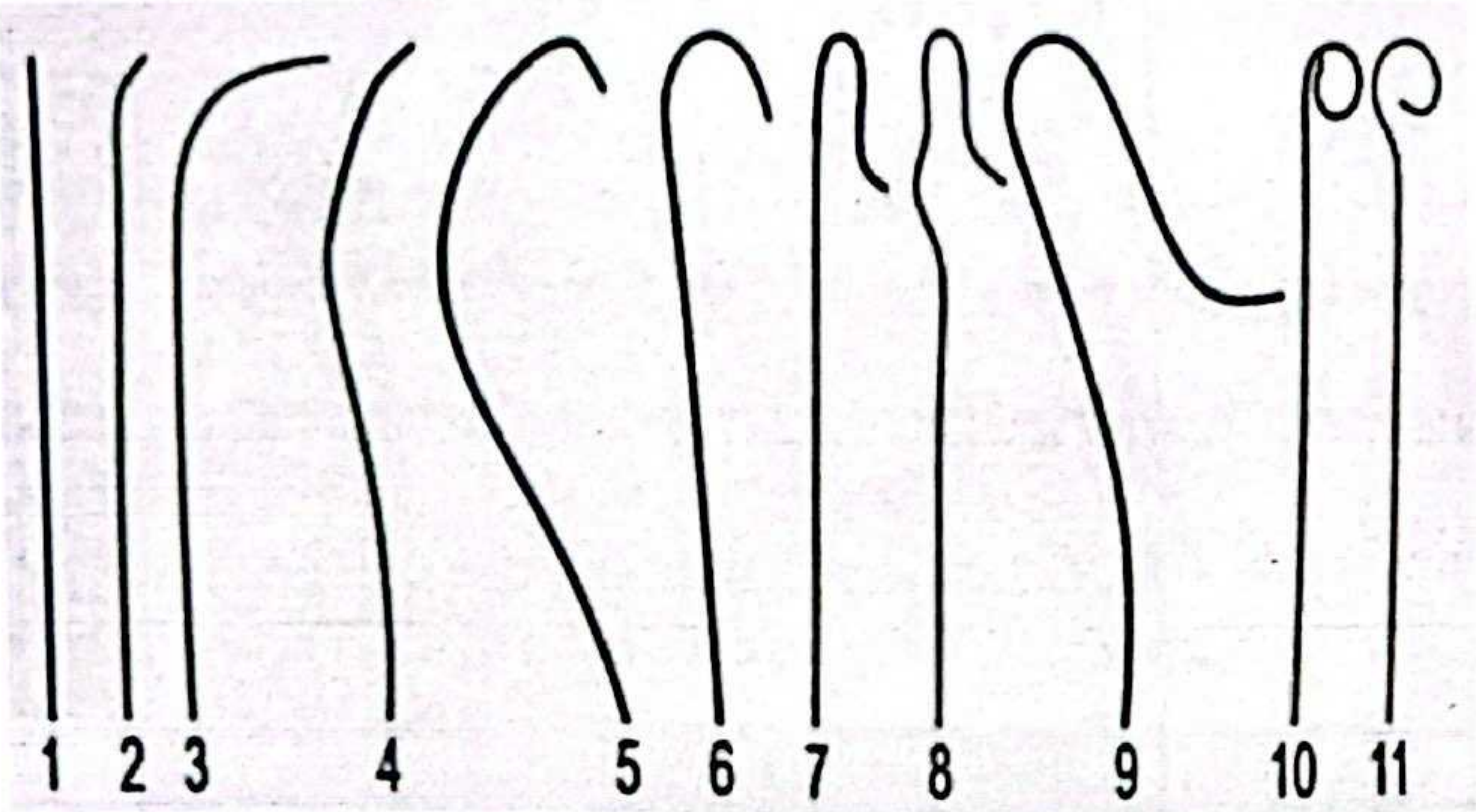
Treatment and management

Mostly no treatment is indicated, because of their high spontaneous regression rate. If symptomatic or causing nasal obstruction they can be surgically resected endoscopically.

Differential diagnosis

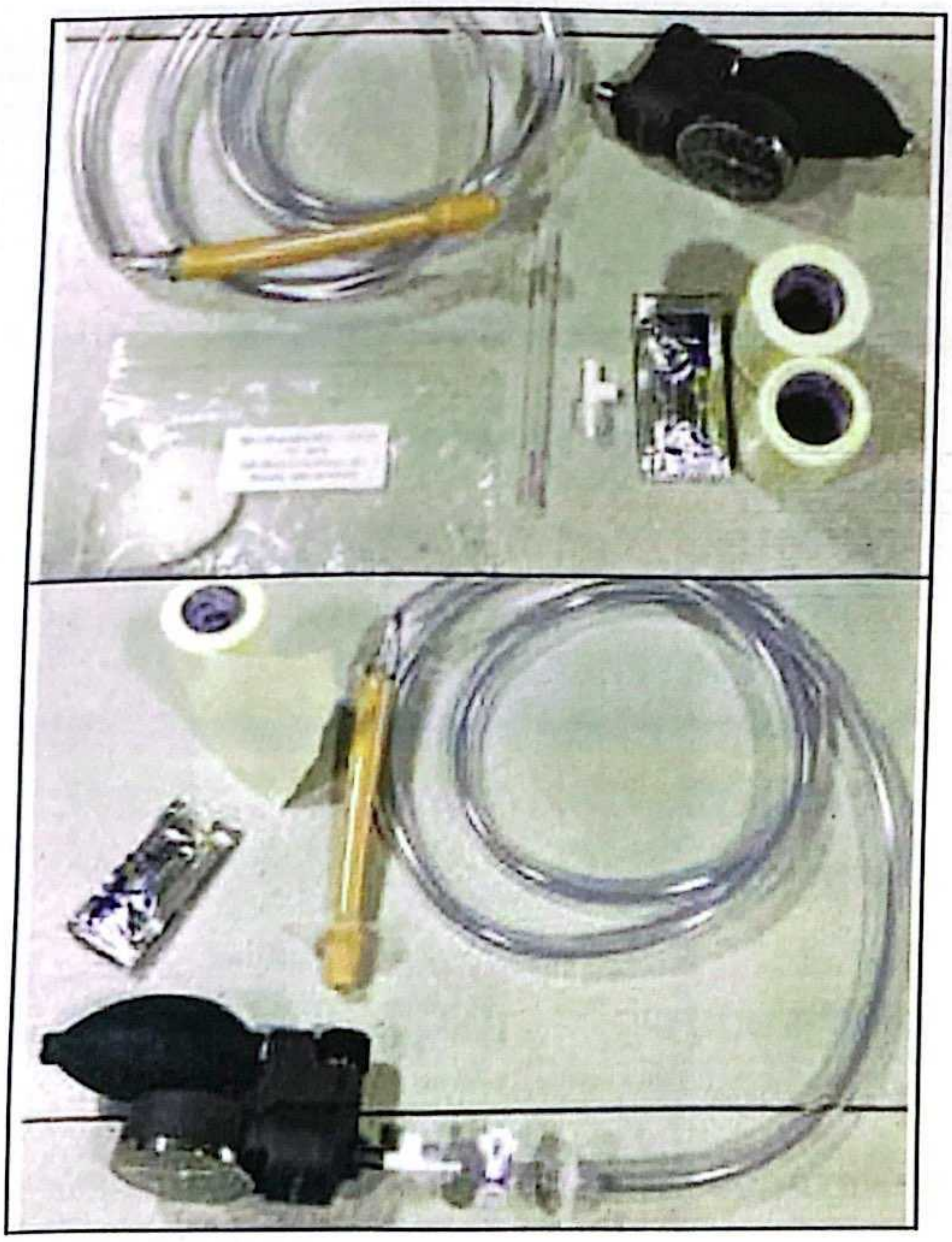
1. Sinonasal polyp
2. Paranasal sinus mucocoele

Q.29)

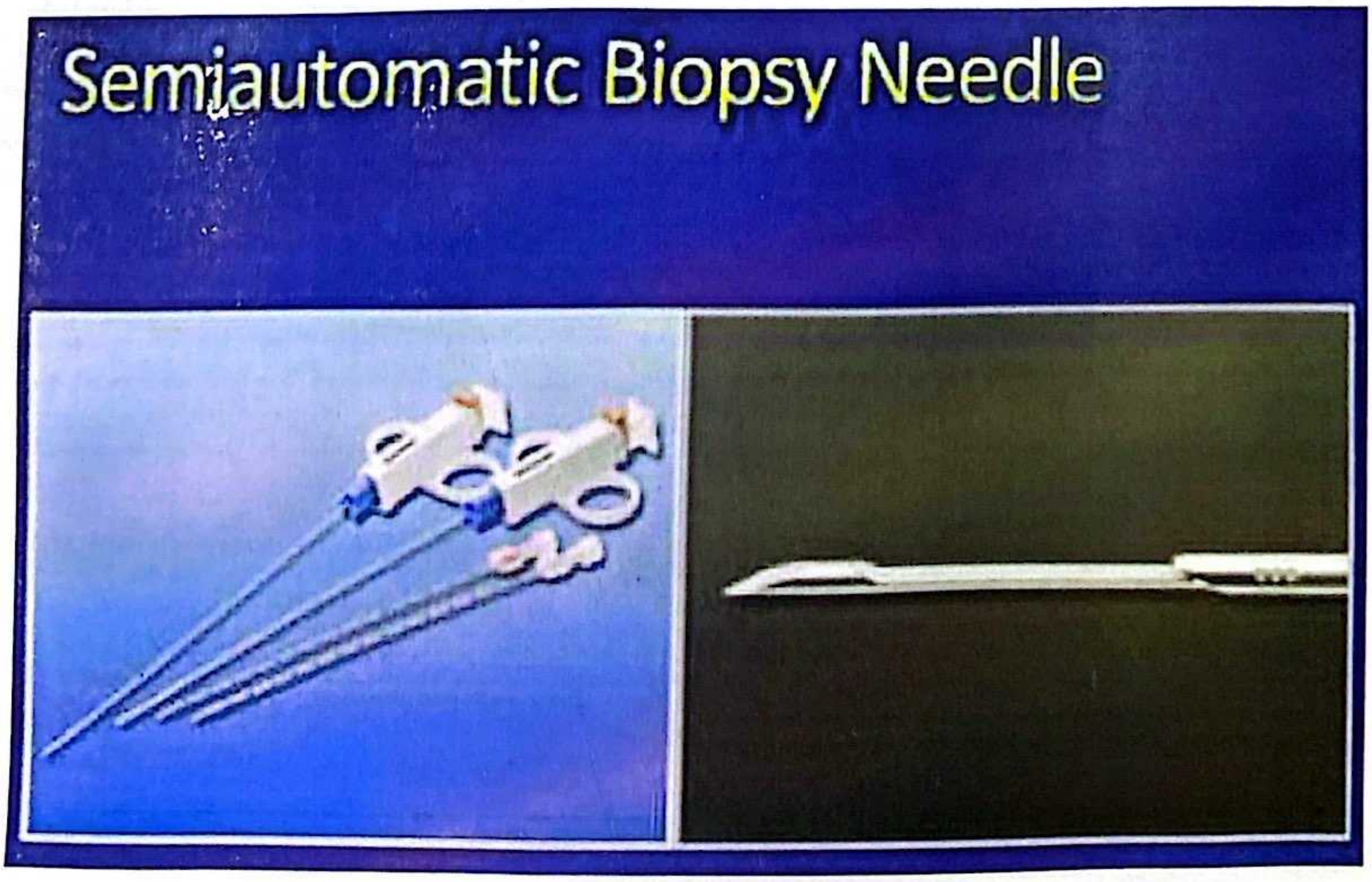


1. Straight
2. Davis (short angled tip)
3. Multipurpose ("hockey-stick")
4. Headhunter (HI)
5. Cobra-2 (cobra-1 has tighter curve, cobra-3 has larger and longer curve);
6. Rosch celiac
7. Visceral (very similar to Simmons)
8. Mickelson
9. Simmons
10. Pigtail
11. Tennis racket.

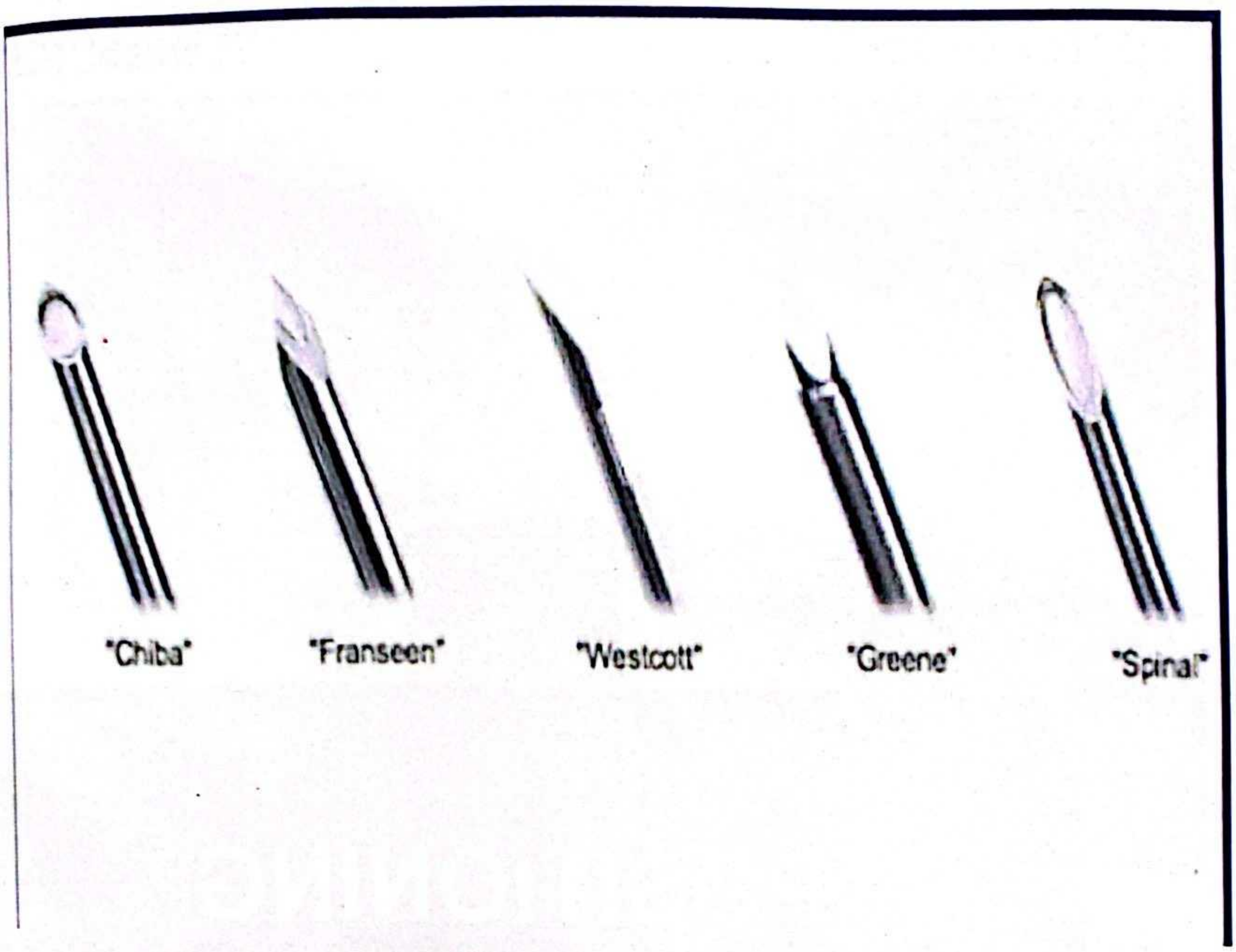
Q.30) Identify **(2015)**

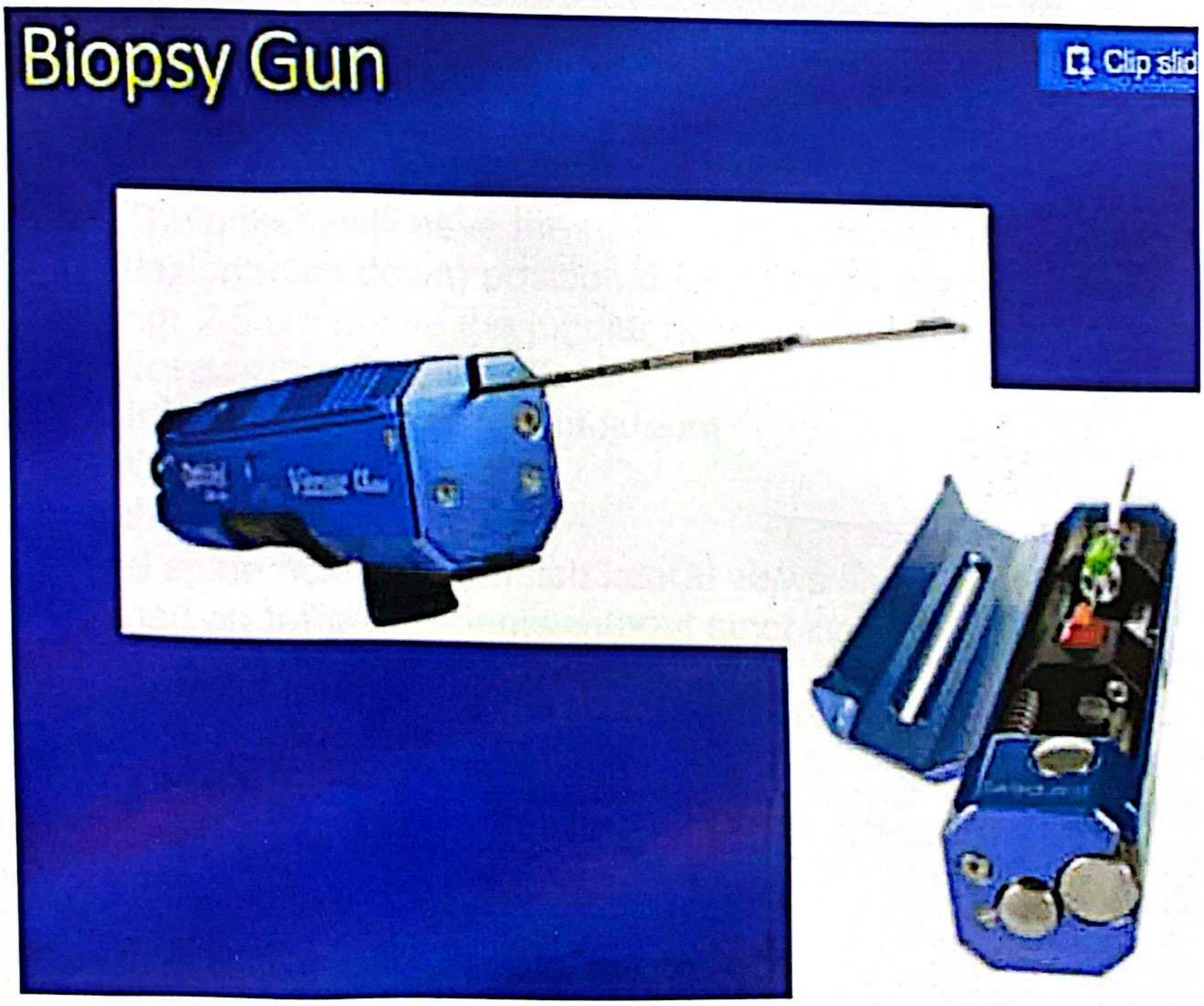


Supplies for air enema: pediatric Shiels catheter with non-balloon tip rectal tube, insufflator with gauge and pop-off valve, lubricating jelly, thin and wide tape, and 18 gauge long needle



Semiautomatic Biopsy Needle


"Chiba"
"Franseen"
"Westcott"
"Greene"
"Spinal"

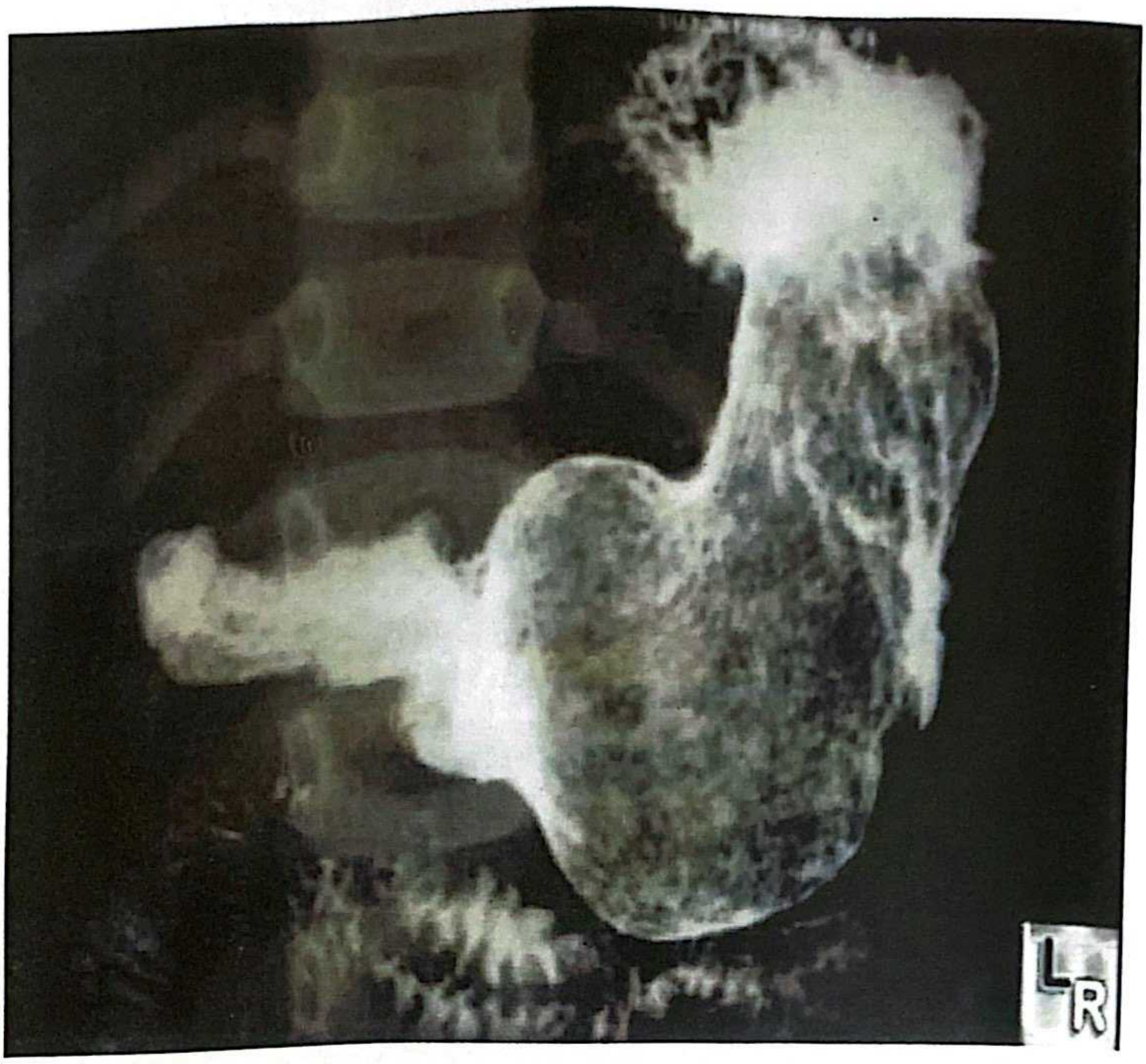


Biopsy Gun

GASTROENTEROLOGY SYSTEM

Bena

Q.1) Mental retardation; alopecia; decrease in appetite for a few months. AGE: 15-Female (2017)



Identify: A spot image of barium meal on fluoroscopic study
Describe: A barium filled stomach with mutiple areas of filling defects giving a mottled appearance
Diagnosis: Trichobezoar (Rapunzel syndrome)
What next: Bezoars are known to cause small bowel obstruction and sometimes **CT** may demonstrate the bezoar as a mass in the obstructed segment of bowel. The bezoar may be outlined by fluid in the proximally dilated small bowel, and the mass may be mottled owing to air trapped within it.
Bezoars are accumulations of indigestible contents within the gastrointestinal tract

Treatment and prognosis
Medical management is restricted to correction of anaemia and weakness. The treatment is essentially surgical. Laporotomy with extraction of bezoar is done with exploration of rest of the small bowel to look for detached bezoars. Small bowel segments showing extensive ulcerations and gangrene are resected.

Psychiatric evaluation is suggested for underlying illness.

Differential diagnosis
gastrointestinal tumour such as a GIST extending into the stomach lumen
other type of bezoar

There are several subtypes depending on the predominant components:

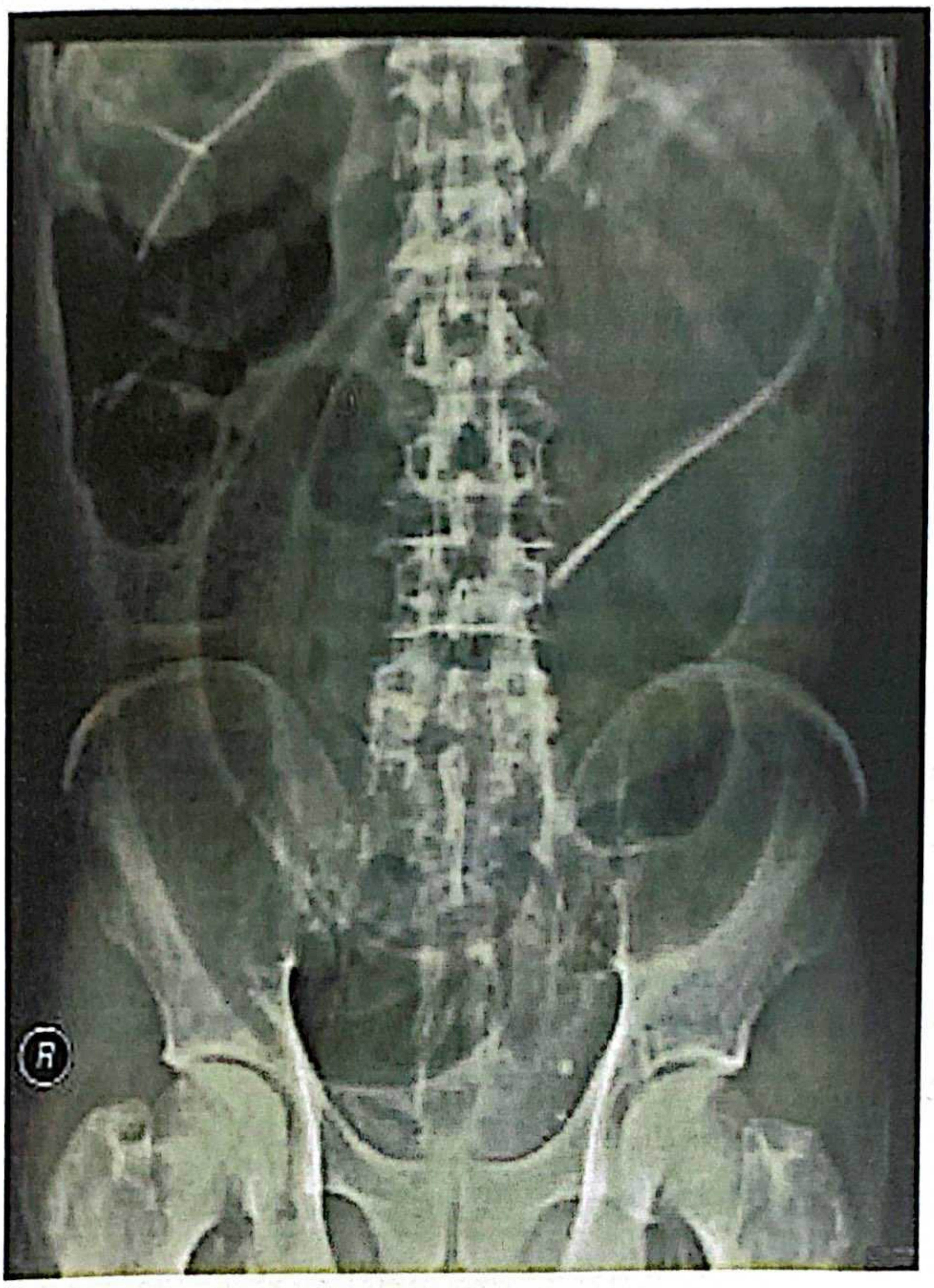
- Trichobezoar: a bezoar formed from hair. This has also been called Rapunzel syndrome when the tail of the trichobezoar extends some distance through the small bowel.
- Phytobezoar: composed of indigestible food material (e.g. cellulose) and are frequently reported in patients with impaired digestion and decreased gastric motility.
- Diospyrobezoar is a subtype of phytobezoar secondary to the consumption of unripe persimmons
- Pharmacobezoar: (or medication bezoars) mostly undigested tablets or semi-liquid masses of drugs.
- Lactobezoar: containing undigested milk curds

Complications

- obstructive jaundice
- mechanical small bowel obstruction
- small bowel perforation
- peritonitis
- acute pancreatitis

Q.2) Severe abdominal pain and clinical features of large bowel obstruction with absent faeces or flatus and a tender and distended abdomen. AGE: 55 years-Female

(2017)



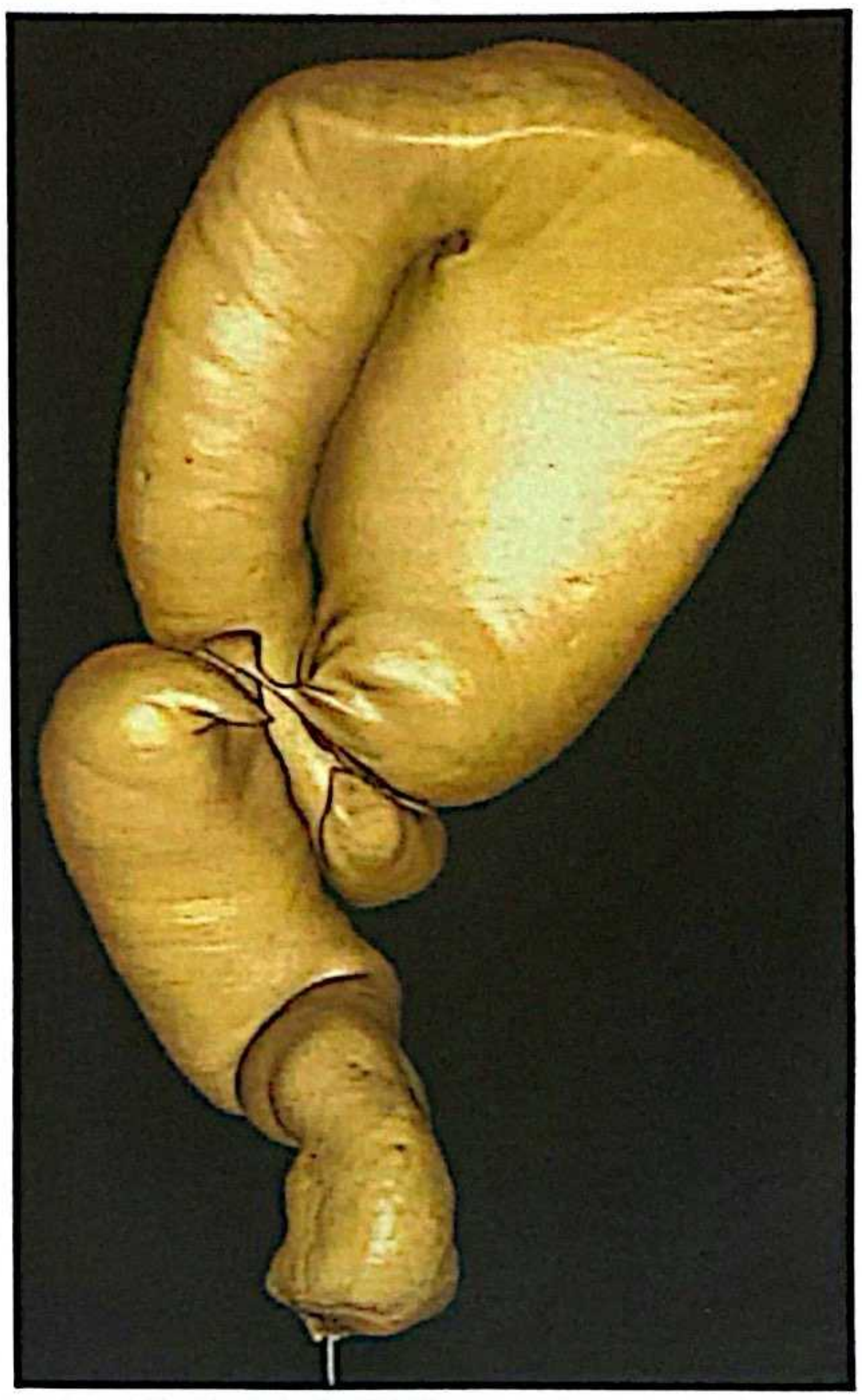
Identify: X-Ray Abdomen Frontal Projection

Describe: Multiple dilated gas-filled loops of bowel. Large central loops of distended large bowel arising from the pelvis with no rectal gas.

Diagnosis: Features most in keeping with sigmoid volvulus

What next: A CT would be more helpful although in most cases (especially where there is a prior history) further imaging is not required and decompression with a flatus tube or rigid sigmoidoscope can be performed. Inform surgeon

Abdominal radiograph



Abdominal radiographs will show a large, dilated loop of the colon, often with a few air-fluid levels.

Specific signs include:

- coffee bean sign
- Frimann-Dahl sign - three dense lines converge towards the site of obstruction
- absent rectal gas

Fluoroscopy

- Although now uncommonly performed, a water-soluble contrast enema exquisitely demonstrates this condition, with the appearances described as the beak sign (or bird beak sign).

CT

- large gas-filled loop lacking haustra, forming a closed-loop obstruction
- whirl sign: twisting of the mesentery and mesenteric vessels
- bird's beak sign: if rectal contrast has been administered 6
- X-marks-the-spot sign: crossing loops of bowel at the site of the transition
- split wall sign: mesenteric fat seen indenting or invaginating the wall of the bowel

Treatment and prognosis

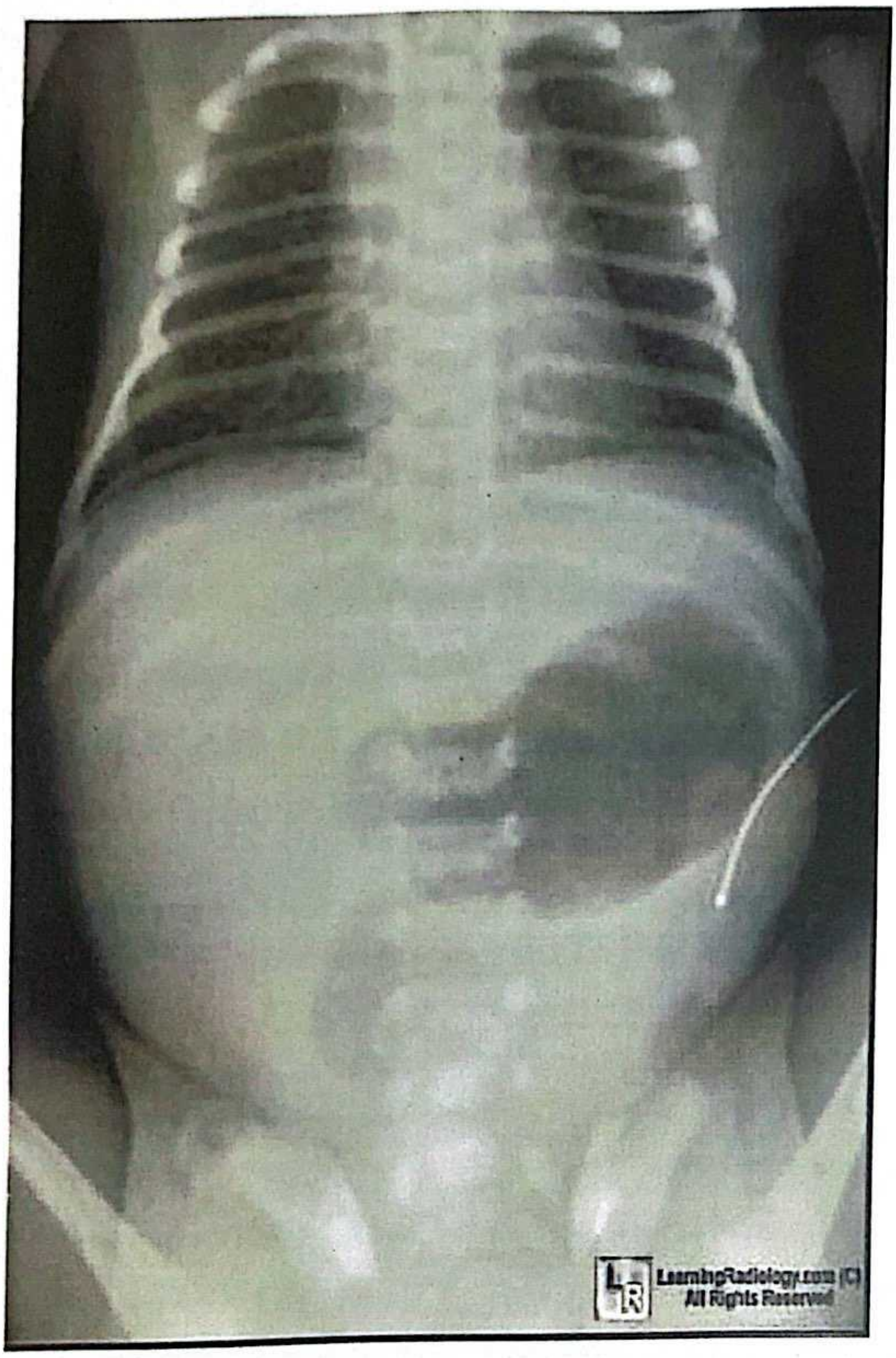
- Rectal tube insertion is successful in treating 90% of cases.
- The most serious complication is bowel ischaemia.

Differential diagnosis

- large bowel obstruction from other causes
- caecal volvulus
- colonic pseudo-obstruction

Q.3) Newborn post emergency C-section at 31 weeks. Born in poor condition with apnoeas.

(2017)



Identify: XRay Abdomen Supine View
Describe: Marked gaseous distension of the stomach and proximal duodenum, with absent bowel gas distally

Abdominal radiographs may classically show a double bubble sign with gas filled distended stomach and duodenum with an absence of distal gas. A similar appearance (either filled with fluid or gas) can be seen in other modalities.

Distal bowel gas although more classically associated with duodenal stenosis, however, it can be seen in duodenal atresia via anomalous bile duct anatomy
Diagnosis: Duodenal atresia

What next: Ultrasound
May also show a dilated stomach and duodenum giving a double bubble type appearance. This, however, may not be sonographically detectable until the mid to late second trimester. May also show evidence of polyhydramnios as an ancillary sonographic feature.

Treatment and prognosis
Surgical treatment for duodenal obstruction includes some different techniques for the intrinsic causes, including duodeno-duodenostomy and duodeno-jejunostomy. With surgical correction prognosis is excellent (especially with isolated cases), and the outlook is therefore largely determined by other associated abnormalities.

Differential diagnosis
For plain radiograph appearances consider:

- duodenal stenosis
- duodenal web
- intestinal malrotation and midgut volvulus
  All three of these will show distal gas:

For an ultrasound appearance of a "double bubble type" appearance also consider

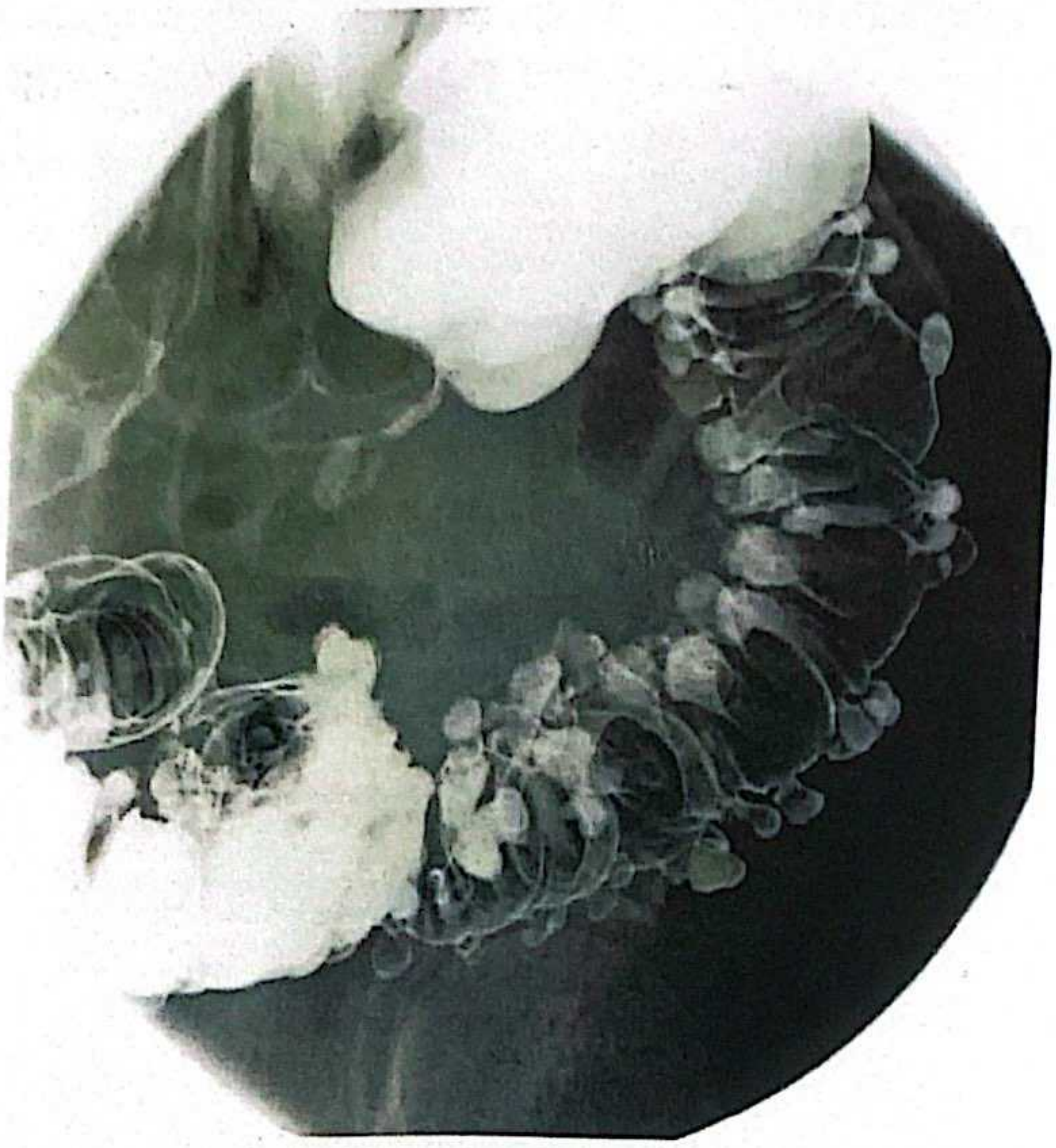
- fetal choledochal cyst
- fetal omental cyst
- fetal enteric duplication cyst

Associated conditions are common and include:

- Down syndrome: ~30% of duodenal atresia cases may have Down syndrome while 3% of Down syndrome cases may have duodenal atresia
- VACTERL association
- annular pancreas
- other intestinal atresias
- jejunal atresia
- ileal atresia
- anal atresia

Q.4) Recurrent bleeding per rectum. Elderly-Female

(2017) (2018)



Identify: Double contrast barium enema study

Describe: Widespread diverticula seen, most numerous in the sigmoid colon. There are no regions of stenosis and no evidence of fistula formation. Both single and double contrast barium enemas are able to demonstrate diverticula as barium-filled outpouchings.

Diagnosis: Colonic diverticula

What next: CT: Diverticula are usually outlined by gas. The colon may be thickened and shortened. On CT Virtual reality colonoscopy, they are seen as complete rings delineating the neck

Treatment and prognosis

The majority of patients remain asymptomatic throughout life and no treatment is required. A high fibre diet may reduce the incidence of diverticula and rate of complications 7. Treatment is usually reserved for diverticulitis of diverticular haemorrhage.

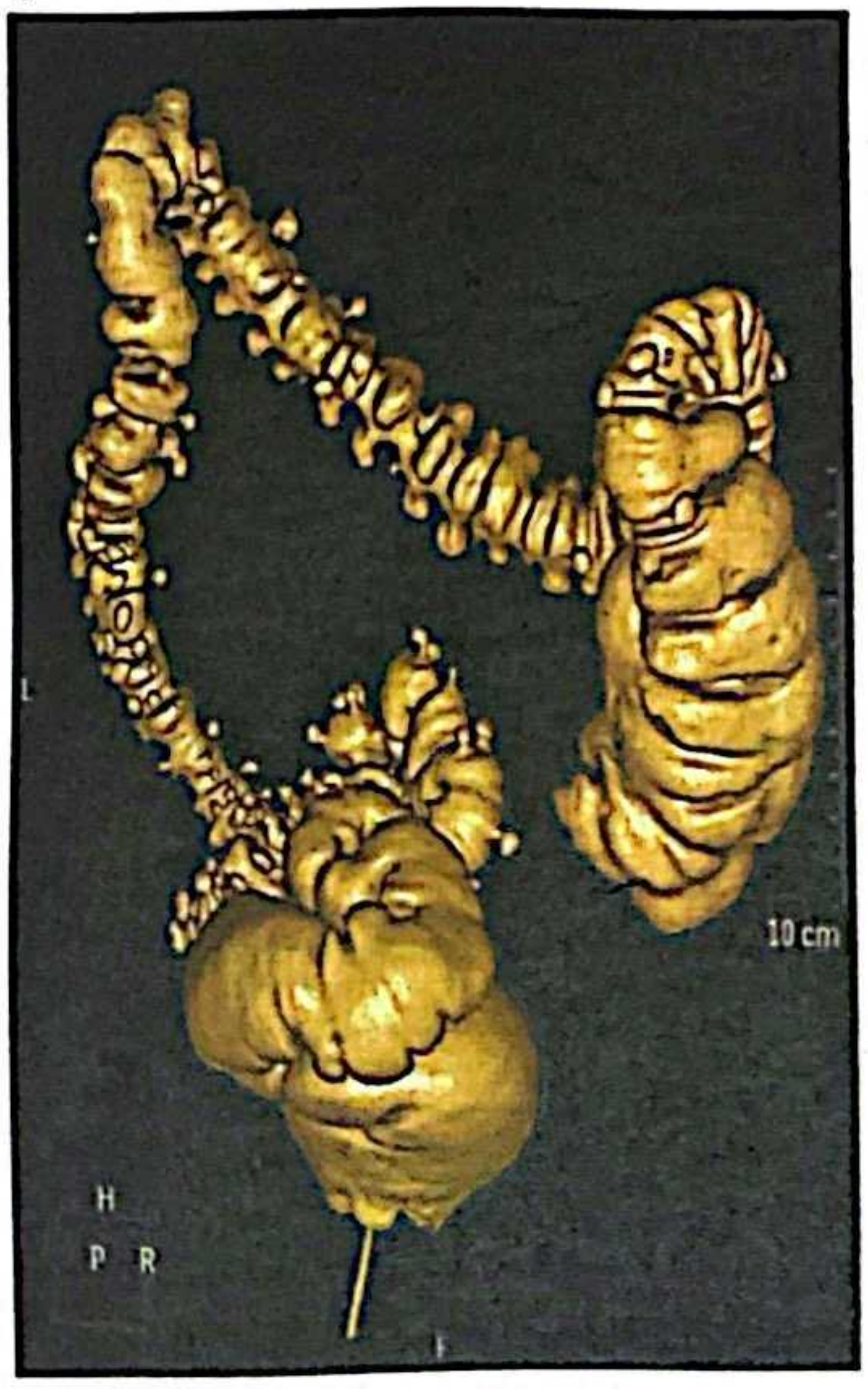
Differential diagnosis

Polyps

- on double contrast barium enema, diverticula must be distinguished from polyps, but this is usually trivial
- when seen en-face they can look similar to polyps but can be distinguished by the presence of pooling contrast within the diverticulum and forming a meniscus
- even if seen on a recumbent overhead film, the two can usually be separated; contrast will often outline the pedicle of the polyp and fade out peripherally, whereas the rounded meniscus pooling in the diverticulum with fade centrally
- on CT VR colonoscopy, diverticula will be seen as complete rings delineating the neck, whereas polyps will have an incomplete ring

Colorectal carcinoma

- rolled/heaped-up shoulders
- short segment
- nodal enlargement
- for more information, see colorectal carcinoma



Colonic strictures can be long (>10 cm) or short.

Short

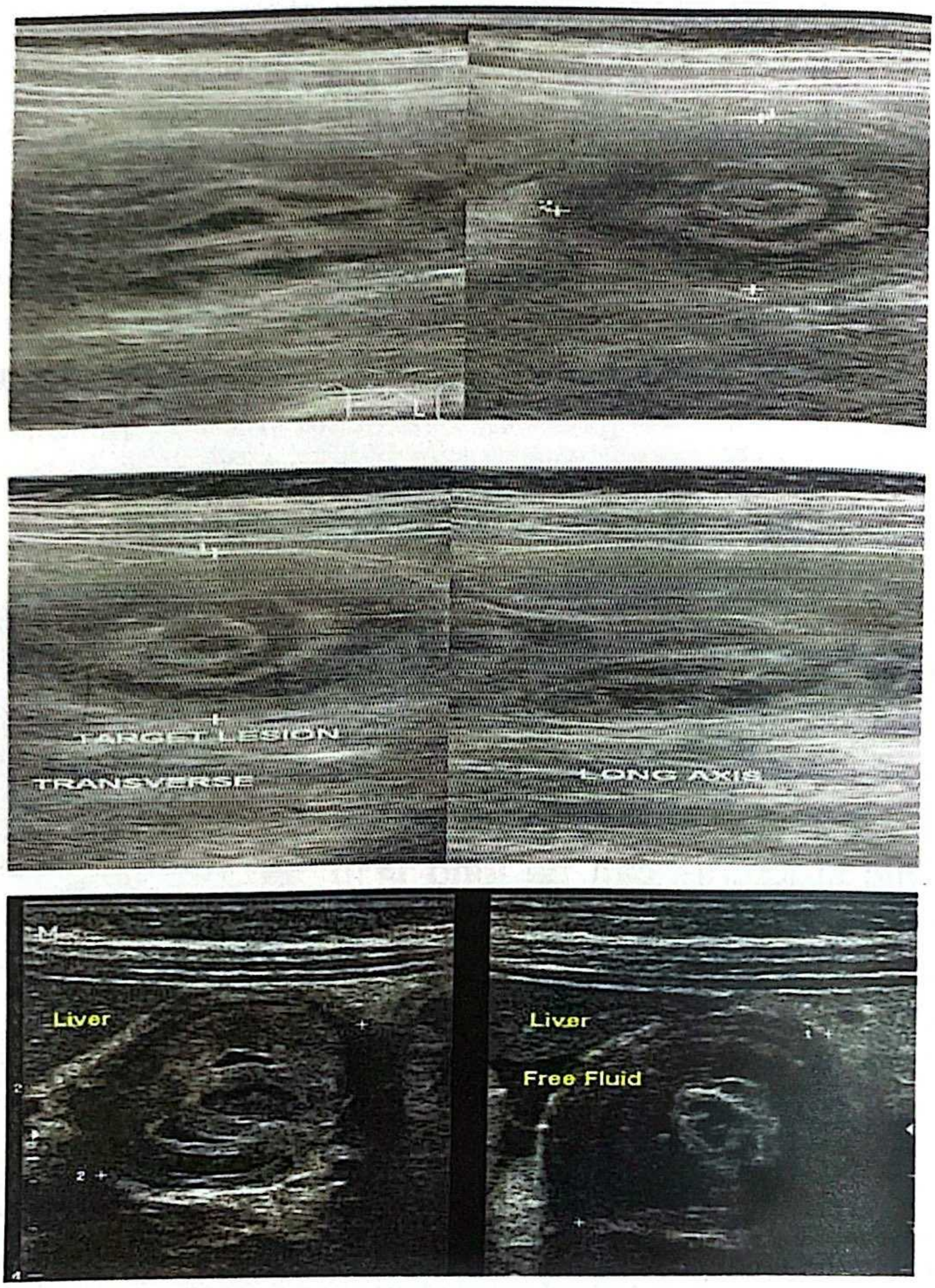
- scirrhous colorectal carcinoma (apple core sign)
- post surgical (anastamotic stricture)

Long

- malignancy
- scirrhous colorectal carcinoma
- gastrointestinal lymphoma
- inflammatory bowel disease (IDB)
- ulcerative colitis
- Crohn disease
- post radiation
- ischaemic stricture

Q.5) Vomiting, bloody stool, and periodical crying. AGE: 5 **months-Male**

(2017)



Identify: Grey Scale Ultrasound Abdomen Transverse and axial section images

Describe: US of the abdomen shows a cylindrical mass consisting of an outer hypoechoic ring surrounding a loop of bowel, consistent with intussusception, with free fluid

Ultrasonography has a false-negative rate approaching zero and is a reliable screening tool for children at low risk for intussusception 5-9. Children with classic findings of intussusception, however, need to be investigated with contrast enema, which is both diagnostic (the gold standard in the diagnosis of intussusception) and therapeutic.

Ultrasound signs include:

- target sign (also known as the doughnut sign)
- pseudokidney sign
- crescent in a doughnut sign

Fluoroscopy

A contrast enema remains the gold standard, demonstrating the intussusception as an occluding mass prolapsing into the lumen, giving the "coiled spring" appearance (barium in the lumen of the intussusceptum and in the intraluminal space). The main absolute contraindication for an enema is perforation, which needs to be treated surgically.

Diagnosis: Intussusception

What next: CT has become the modality of choice for assessment of acute abdomen in adults, and thus most frequently images intussusception. Also, short length transient intussusception is a frequent incidental finding.

The appearance of intussusception on CT is characteristic and depends on the imaging plane and where along the bowel the images are obtained.

Best known is the so-called bowel-within-bowel configuration, in which the layers of the bowel are duplicated forming concentric rings (CT equivalent of the ultrasonographic target sign) when imaged at right angles to the lumen, and a soft tissue sausage when imaged longitudinally

Treatment

Intussusception reduction is a procedure performed in paediatric patients who have an ileocolic intussusception.

There are several ways that reduction can be achieved radiologically:

- air-reduction under fluoroscopic guidance
- water-reduction under fluoroscopic guidance
- physical reduction under US guidance

REDUCTION OF AN INTUSSUSCEPTION

This procedure should only be attempted in full consultation with the surgeon in charge of the case and when an anaesthetist with adequate paediatric training and experience

Methods

1. Using air and fluoroscopy3 – barium is no longer used in the majority of centres as air reduction has the following advantages:
   a. more rapid reduction, because the low viscosity of air permits rapid filling of the colon
   b. reduced radiation dose because of the above
   c. more effective reduction
   d. in the presence of a perforation, air in the peritoneal cavity is preferable to barium, and gut organisms are not washed into the peritoneal cavity
   e. there is more accurate control of intraluminal pressure
   f. less mess, and a dry infant will not lose heat
   g. less expensive.
2. Using a water-soluble contrast medium and US.

Contraindications

1. Peritonitis or perforation
2. The pneumatic method should probably not be used in children over 4 years of age as there is a higher incidence of significant lead points which may be missed
3. Successful reduction is less likely in patients with prolonged symptoms or radiographic signs of obstruction, but this does not preclude an attempt at reduction if the patient is well hydrated and stable

Contrast medium

1. Air
2. Barium sulphate 100% w/v (now rarely used)
3. Water-soluble contrast, e.g. LOCM 150 or dilute Gastrografin (1 part Gastrografin to 4 or 5 parts water).

Technique

A 16–22-F balloon catheter is inserted into the rectum and the buttocks taped tightly together to provide a seal. It may be necessary to inflate the balloon but if this is done it should be performed under fluoroscopic control so that the rectum is not over distended

Pneumatic reduction

1. The child is placed in the prone position so that it is easier to maintain the catheter in the rectum and the child is disturbed as little as possible during the procedure.
2. Air is instilled by a hand or mechanical pump and the intussusception is pushed back by a sustained pressure of up to 80mmHg. If this fails, the pressure may be increased to 120mmHg.

Pressure should be monitored at all times and there should be a pressure release valve in the system to ensure that excessive pressures are not delivered.

3. Reduction is successful when there is free flow of air into the distal ileum.
4. If the intussusception does not move after 3 min of sustained pressure, the pressure is reduced and the child rested for 3 min. If, after three similar attempts, the intussusception is still immovable it is considered irreducible and arrangements are made for surgery.
5. The intussusception is only considered completely reduced when the terminal ileum is filled with air

Ultrasound reduction

1. To facilitate scanning the child must be supine.
2. The intussusception can be identified with US. The contrast medium is run as far as the obstruction and its passage around the colon and the reducing head of the intussusception monitored by US.
3. The points regarding failed or incomplete reduction discussed above also apply to this technique.

Complication: The main risk of reduction is a perforation

Contraindications

- signs of peritonitis
- perforation

Differential diagnosis

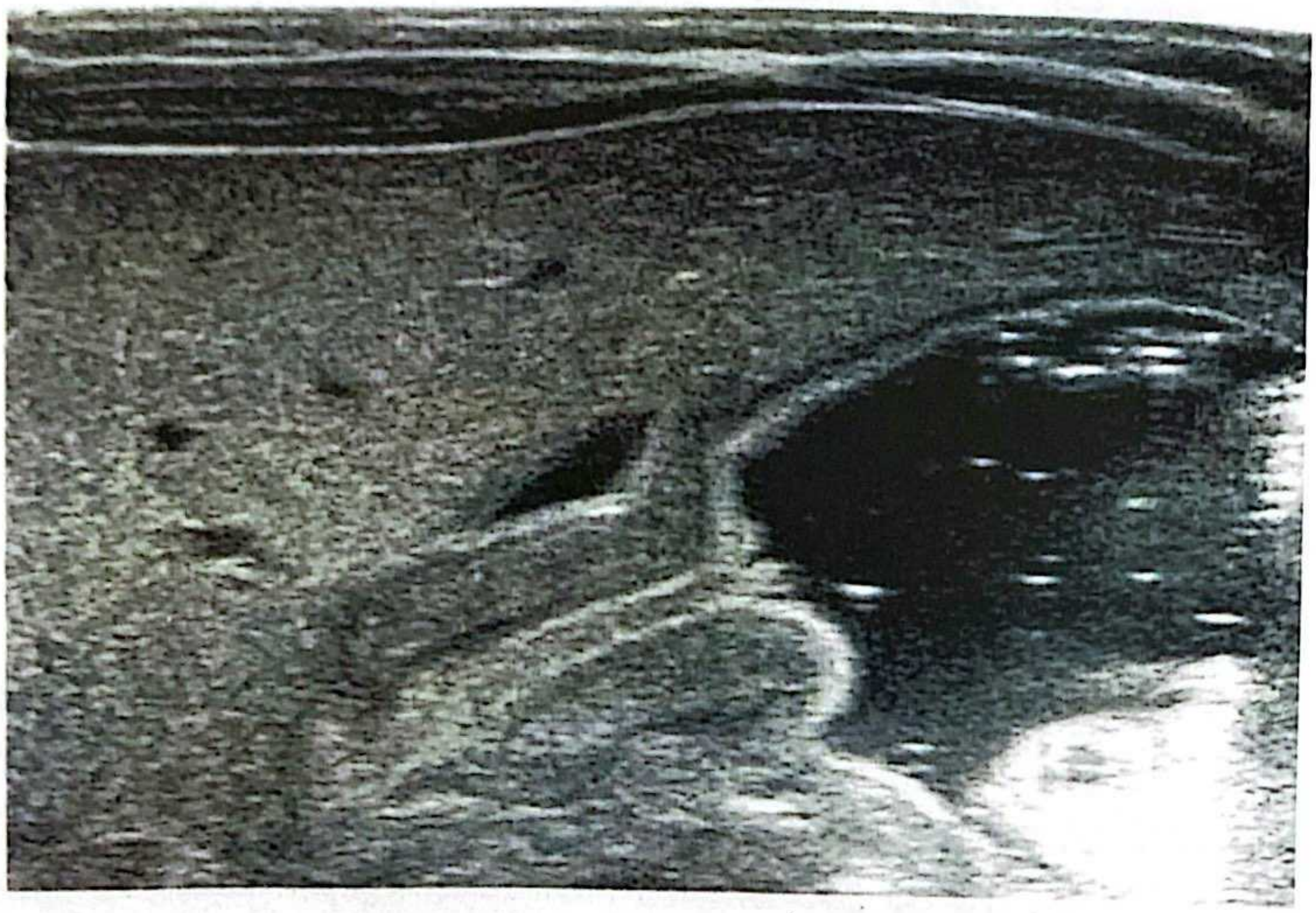
On imaging the appearances on ultrasound and CT are characteristic. The main differential is that of transient intussusception, which is an incidental finding requiring no treatment or follow-up.

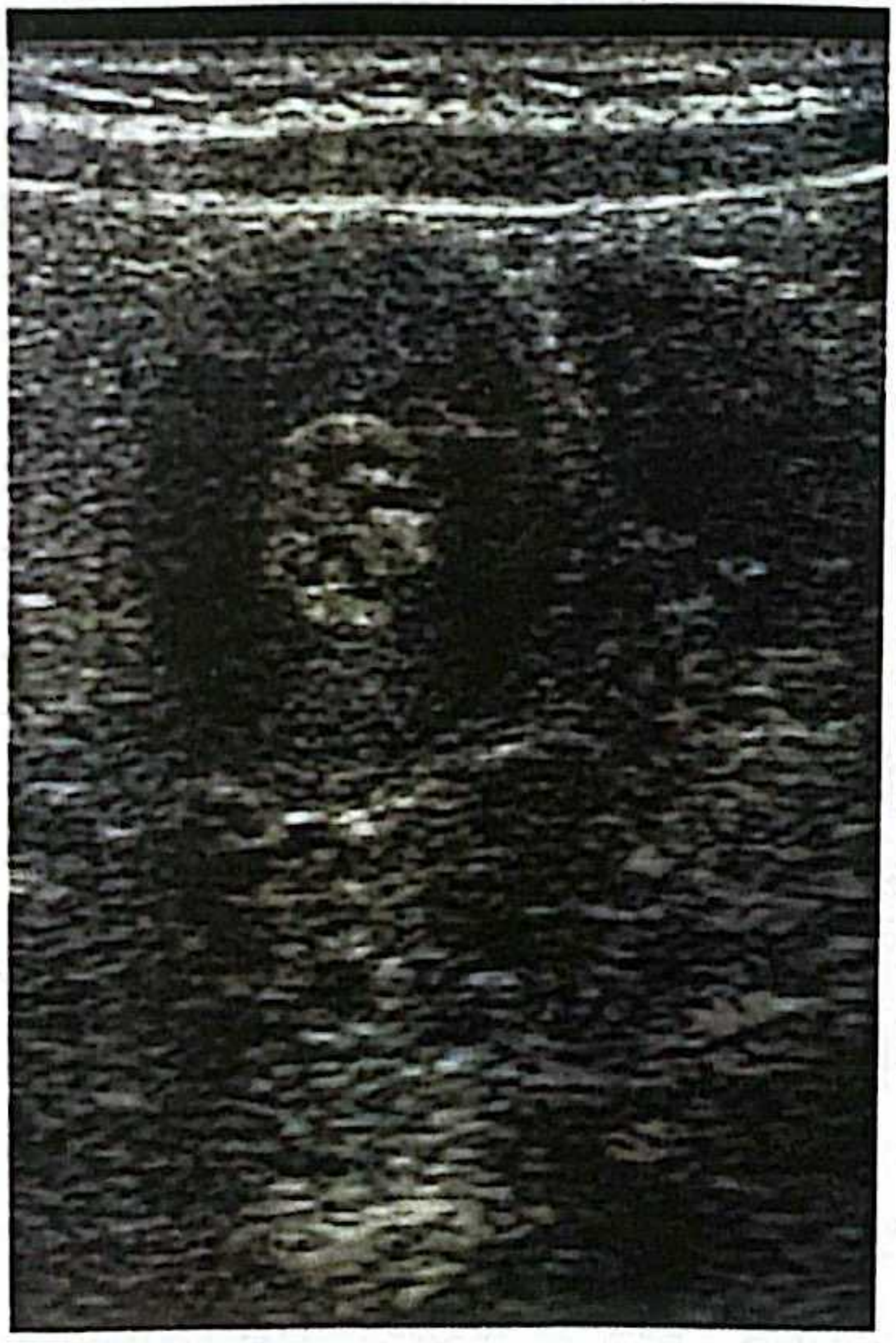
Other conditions to be considered in adults include:

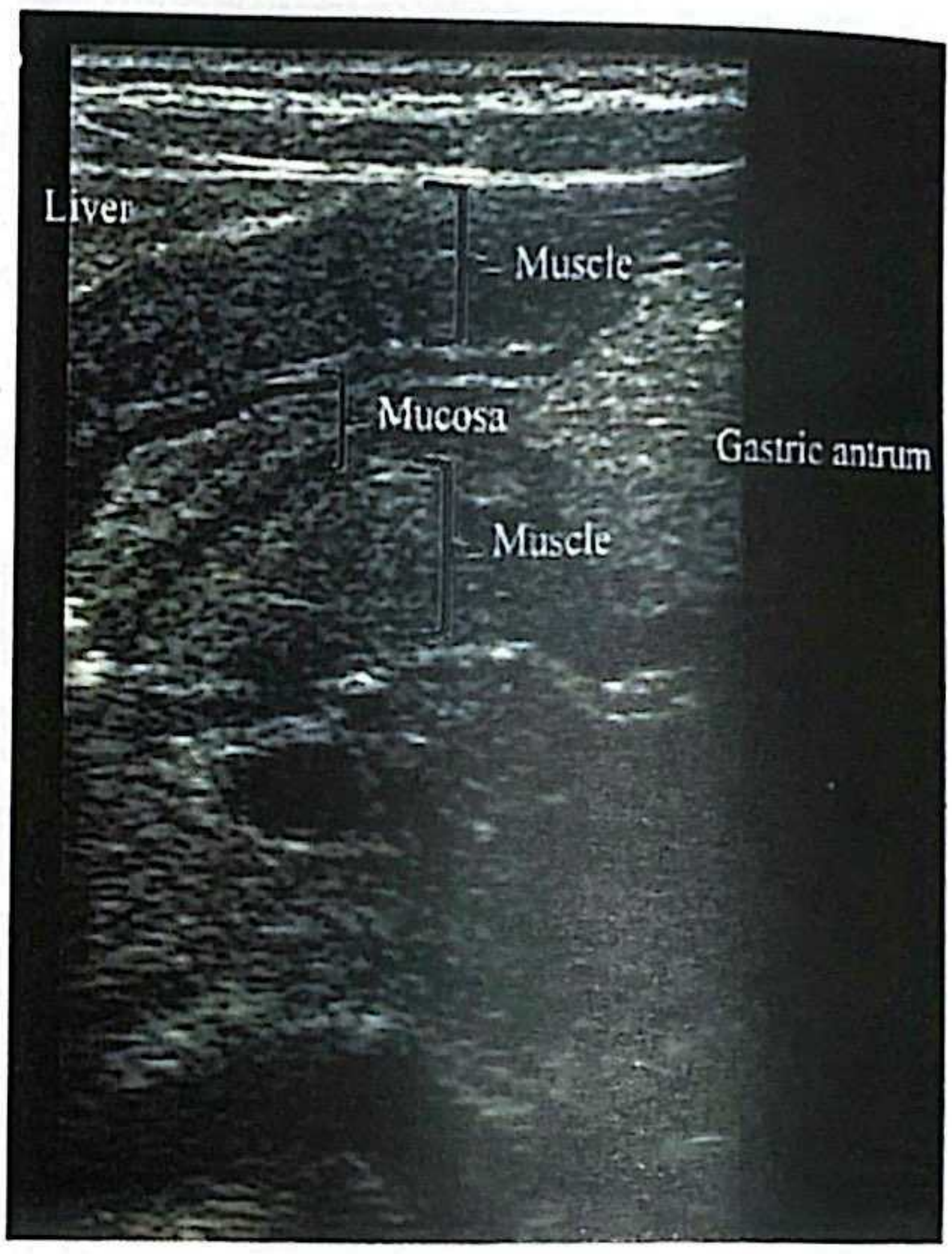
- primary bowel tumour
- metastases and lymphoma
- intestinal lipoma (without intussusception)
- Meckel diverticulum
- gallstone ileus (cholesterol stones can have a layered appearance with fat density)
- endometrial implant

Q.6) Projectile vomiting. AGE: 6 weeks-Female

(2017)







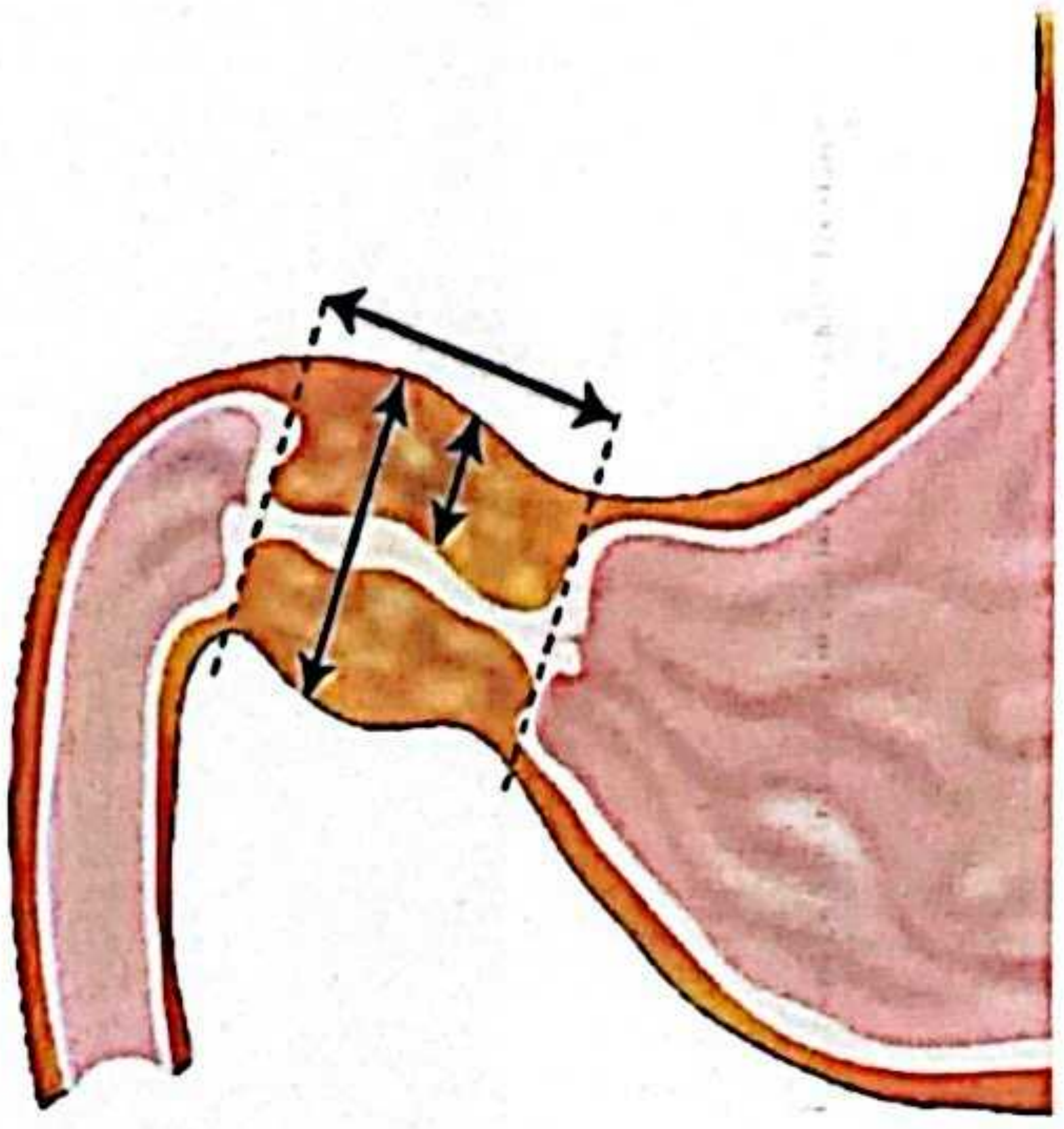
Identify: Greyscale Ultrasound Abdomen Longitudinal Section & Transverse Section

Describe: Stomach appears dilated with liquid and food particles and pylorus appear enlarged. The length was enlarged 16 mm (upper limit of normal 14 mm), and the muscle was thickened 4 mm (upper limit of normal 3 mm).

This image also shows the "antral nipple sign" - redundant pyloric mucosa protruding into the gastric antrum, and the "cervix sign" - indentation of the pylorus into the fluid-filled antrum. The most telling sign can be no gastric contents seen to pass through the pylorus at any time during the examination

Ultrasound findings include:

- target sign: hypertrophied hypoechoic muscle surrounding echogenic mucosa (In Transverse Section)
- elongated pylorus with thickened muscle
- cervix sign
- antral nipple sign
- failure of the pylorus to open



Normal values *

Length: <15mm
Single muscle thickness: <3mm
Pyloric width: <7mm

Diagnosis: Hypertrophic pyloric stenosis

What next:

Fluoroscopy

An upper gastrointestinal series (barium meal) excludes other, more serious causes of pathology:

- delayed gastric emptying
- peristaltic waves (caterpillar sign)
- elongated pylorus with a narrow lumen (string sign) which may appear duplicated due to puckering of the mucosa (double-track sign)
- the pylorus indents the contrast-filled antrum (shoulder sign) or base of the duodenal bulb (mushroom sign)
- the entrance to the pylorus may be beak-shaped (beak sign)

Treatment and prognosis

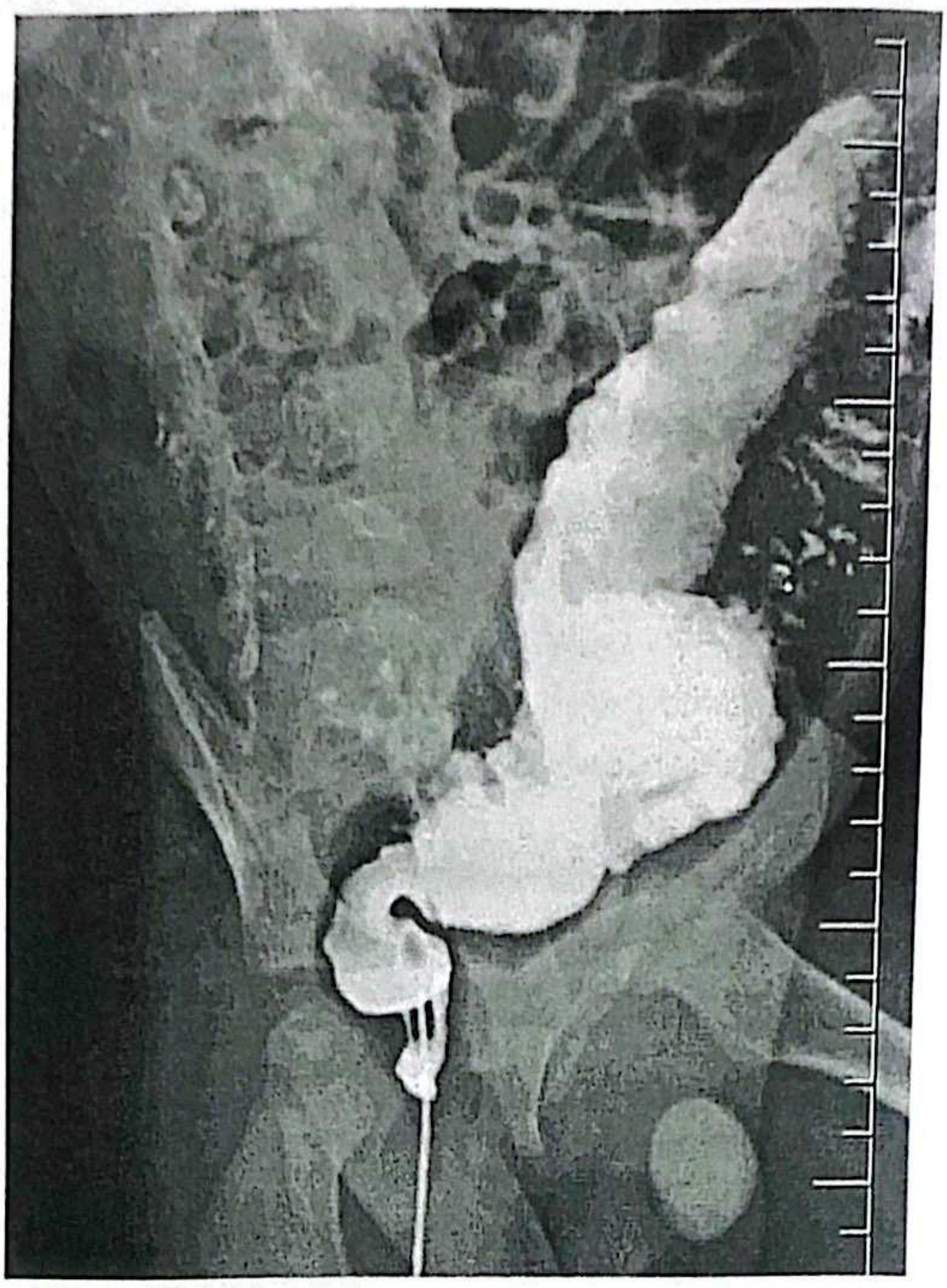
Initial medical management is essential with rehydration and correction of electrolyte imbalances. This should be completed prior to surgical intervention. Treatment is surgical with a pyloromyotomy in which the pyloric muscle is divided down to the submucosa. This can be performed both open and laparoscopically. The operation is curative and has very low morbidity

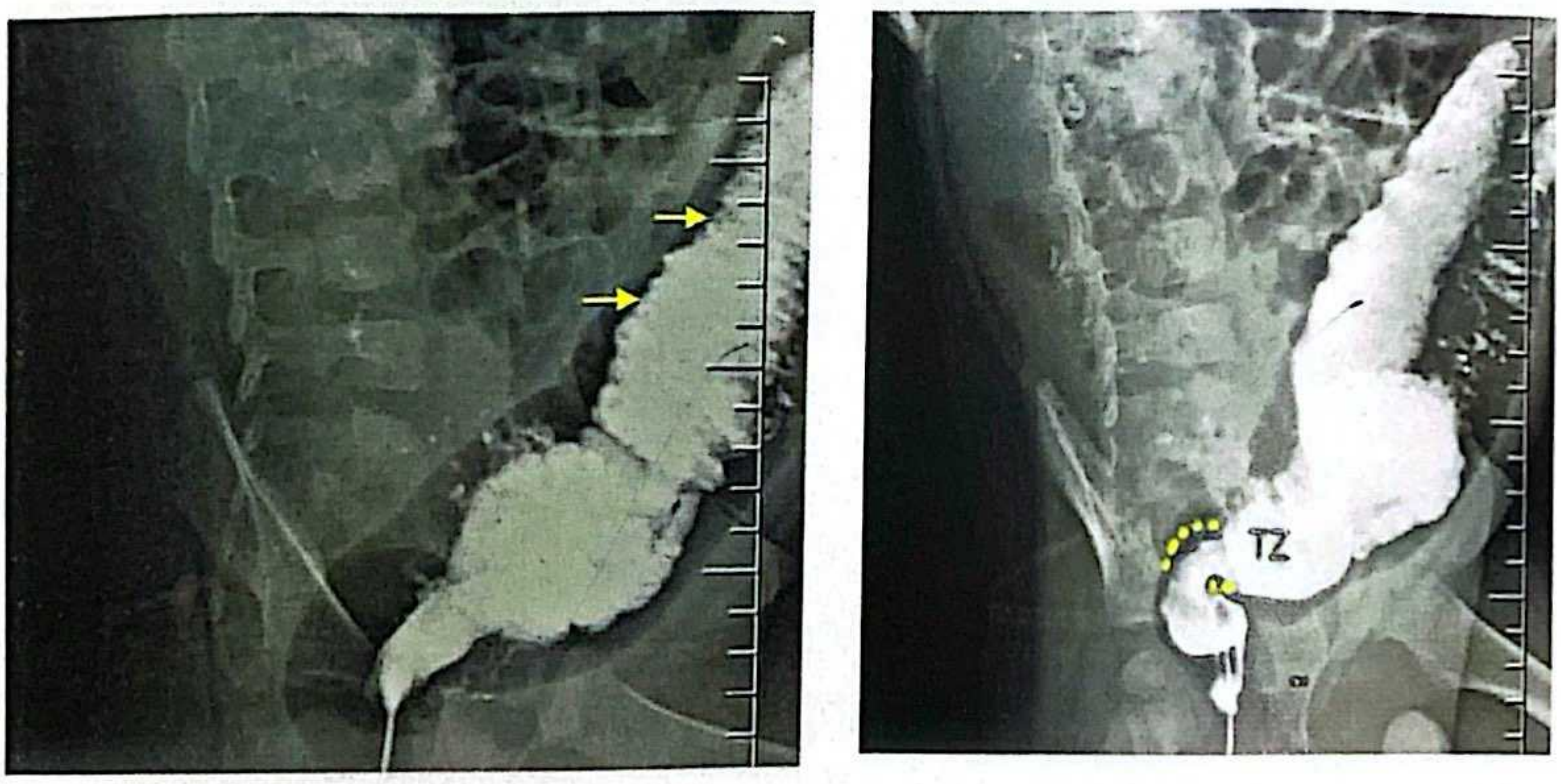
Differentials of obstruction signs may Include:

- midgut volvulus
- gastric antral web
- duodenal web/stenosis
- annular pancreas
- bezoar

Q.7) Constipation. AGE: 2- Male

(2017





Short narrowed segment indicated between the dotted lines; TZ = transition zone
Arrows indicate the small bowel (jejunal) pattern to the descending colon

Identify: Barium Enema Spot Image

Describe: There is narrowing of recto-sigmoid segment of intestine, proximal dilatation of the colon, 'jejunisation' of the descending colon

Diagnosis: Hirschsprung disease (short segment type)

What next: Fluoroscopy

A carefully performed contrast enema is indispensable in both the diagnosis of Hirschsprung disease but also in assessing the length of involvement. It should be noted however that the depicted transition zone on the contrast enema is not accurate at determining the transition between absent and present ganglion cells.

The affected segment is of small calibre with proximal dilatation. Fasciculation/saw-tooth irregularity of the aganglionic segment is frequently seen.

Views of particular importance include:

- early filling views that include rectum and sigmoid colon allowing for rectosigmoid ratio to be determined.
- transition zone

Treatment and prognosis

Surgical treatment is by removal of the affected portion of the colon

Differential diagnosis

- functional megarectum
- necrotising enterocolitis
- microcolon: appears similar to long segment / whole colon Hirschsprung disease

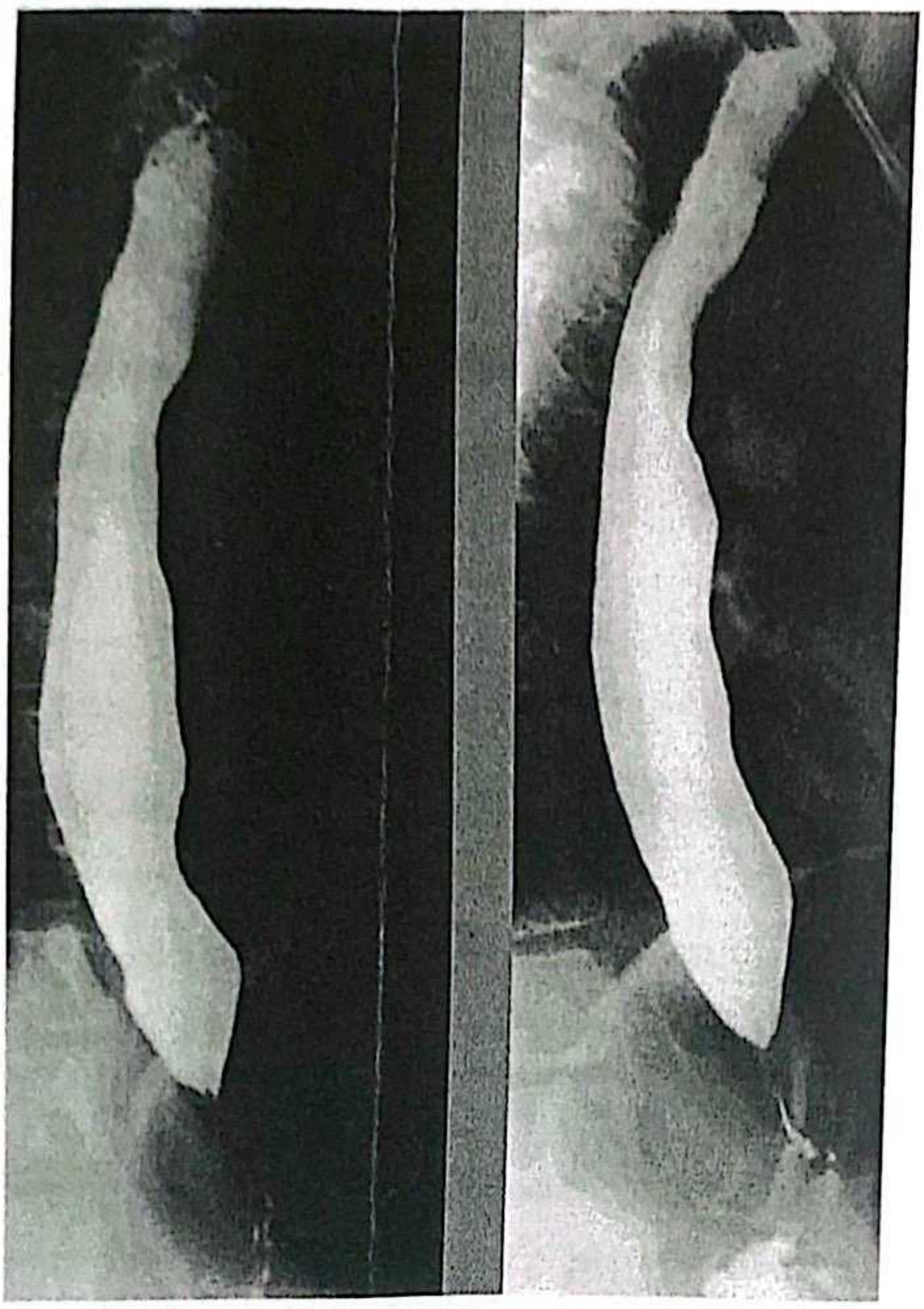
Associations

Although Hirschsprung is an isolated abnormality in 70% of cases, there are some well-documented associations, including:

- Down syndrome: in 10% of Hirschsprung cases
- neurocristopathy syndromes
- Waardenburg-Shah syndrome
- Haddad syndrome
- MEN IIa
- neuroblastoma
- other non-neurocristopathy syndromes
- Aarskog syndrome
- Bardet-Biedl syndrome
- Fryns syndrome
- Pallister-Hall syndrome
- Smith-Lemli-Opitz syndrome

Q.8) Patient present with dysphagia and chest discomfor
AGE: Middle Age-Male

(2016)



Identify: Barium Swallow Oblique View Spot Image of Distal Esophagus

Describe: Acute tapering at the lower esophageal sphincter and narrowing at the gastro-esophageal junction, producing a "bird's beak" or "rat's tail" appearance.

A barium swallow can confirm:

- bird beak sign
- oesophageal dilatation
- pooling or stasis of barium in the oesophagus when the oesophagus has become atonic or non-contractile (late feature in the disease)
- incomplete LOS relaxation that is not coordinated with oesophageal contraction
- failure of normal peristalsis to clear the oesophagus of barium when the patient is in the recumbent position, with no primary waves identified
- uncoordinated, non-propulsive, tertiary contractions

- when barium column is high enough (patient standing) the hydrostatic pressure can overcome the LOS pressure allowing passage of oesophageal content

Diagnosis: Achalasia

What next:

CT

Patients with uncomplicated achalasia demonstrate a dilated, thin walled oesophagus filled with fluid/food debris. Overall, CT has little role in directly assessing patients with achalasia, but is useful in assessing common complications. Careful assessment of the wall of the oesophagus should be undertaken to identify any focal regions of thickening which may indicate malignancy. The lungs should be inspected for evidence of aspiration.

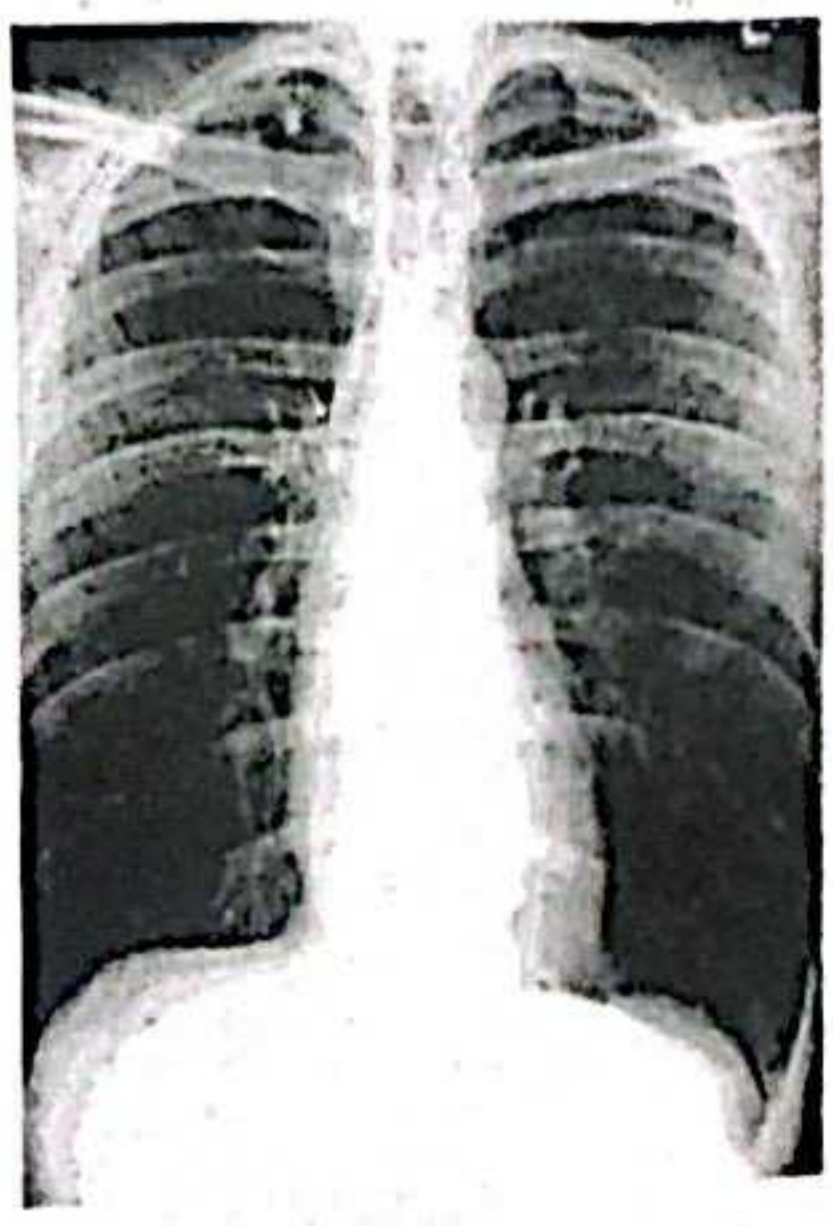
Treatment is aimed at allowing adequate drainage of the oesophagus into the stomach

- lifestyle changes
- calcium channel blockers
- pneumatic dilatation
- botulinum toxin injection
- surgical myotomy (e.g. Heller myotomy)

Differential Diagnosis:

- Neoplasm (separation of gastric fundus from diaphragm; normal peristalsis; asymmetric tapering)
- Peptic stricture of esophagus

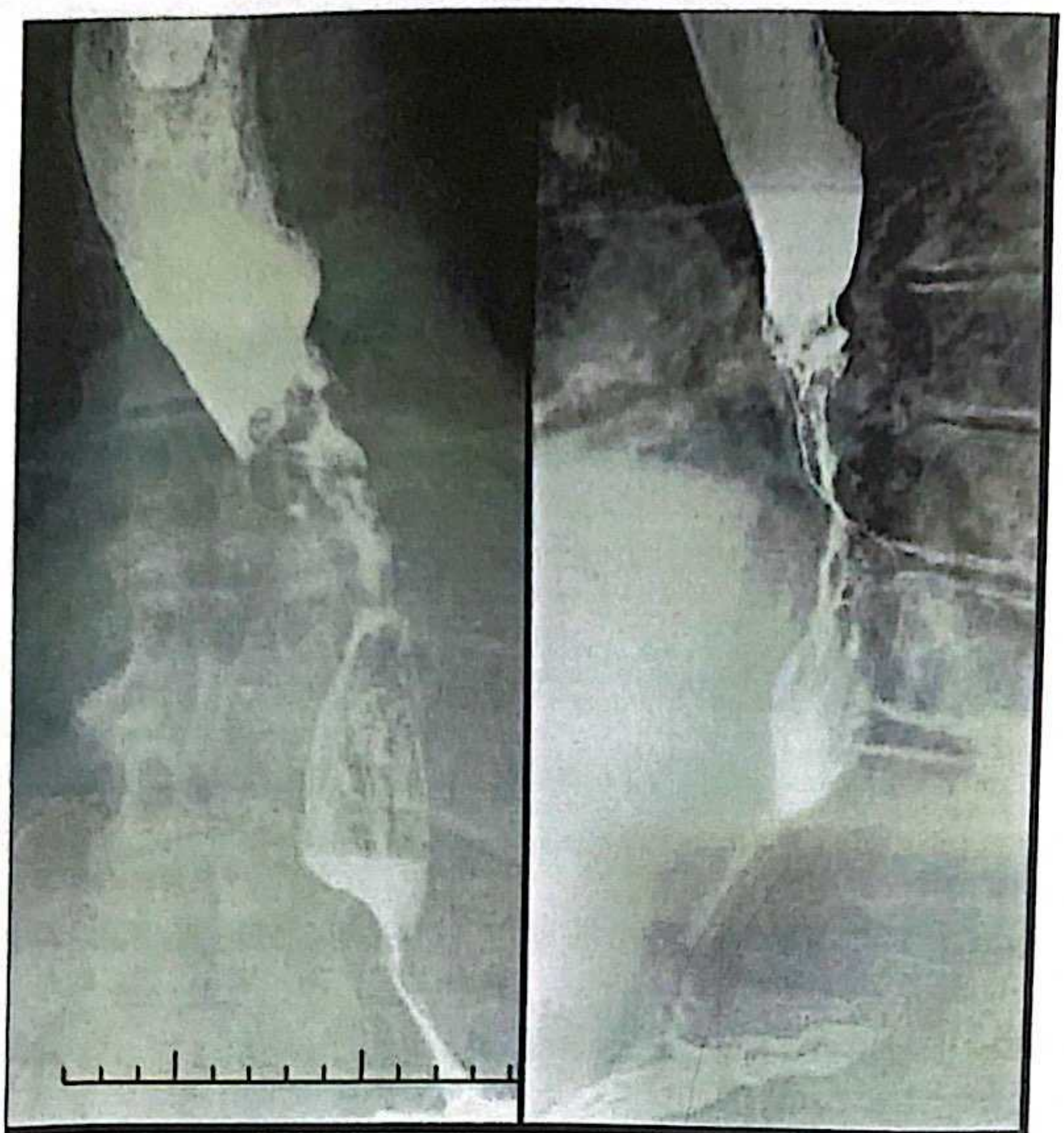
Achalasia Chest x-ray findings include:



- right convex opacity behind the right cardiac border; occasionally left convex opacity if the thoracic aorta is tortuous
- air-fluid level due to stasis in a thoracic oesophagus filled with retained secretions and food
- small or absent gastric air bubble
- anterior displacement and bowing of the trachea on the lateral view
- patchy alveolar opacities, usually bilateral, may be seen: represent acute pneumonitis or chronic aspiration pneumonia

Q.9) Long history of scleroderma. Increasing dysphagia to solids. AGE: 60-Female

(2015)



Identify: Barium swallow spot film image of lateral oblique view

Describe: Images show food material within the upper thoracic oesophagus which is somewhat dilated. Distal to this there is a 5 cm irregular narrowing of the mid thoracic oesophagus with proximal shouldering with hold-up of contrast Apple core appearance. Beyond this there is a short segment of non-strictured oesophagus before there is another 5 cm segment of smooth luminal narrowing extending to the gastro-oesophageal junction.

Diagnosis: Scleroderma with oesophageal cancer and peptic stricture

What next:

Endoscopic US

- It is the most accurate imaging modality for the T staging of oesophageal cancer
- It defines the layers of the oesophageal wall hence can differentiate T1, T2, and T3 tumors

The oesophagus consists of five layers.

1. the first hyperechoic layer represents the interface between the balloon and the superficial mucosa.
2. the second hypoechoic layer represents the lamina propria and muscularis mucosae.

3. the third hyperechoic layer represents the submucosa
4. the fourth hypoechoic layer represents the muscularis propria
5. the fifth layer represents the interface between the adventitia and surrounding tissues

CT

- eccentric or circumferential wall thickening >5 mm
- peri-oesophageal soft tissue and fat stranding
- dilated fluid- and debris-filled oesophageal lumen is proximal to an obstructing lesion
- tracheobronchial invasion appears as a displacement of the airway (usually the trachea or left mainstem bronchus) as a result of mass effect by the oesophageal tumour aortic invasion

FDG PET/CT

- PET/CT is useful for detecting oesophageal primary tumors yet it has little role in helping determine the specific T classification because it provides limited information about the depth of tumor invasion.
- PET/CT is also superior to CT for detecting lymph node metastases and can depict metastases in normal-sized lymph nodes through the uptake of FDG.
- PET/CT has a primary role in the depiction of distant sites of metastatic disease.
- The most common sites of distant metastases detected at PET (but frequently missed at CT) are the bones and liver.

Complications

- fistula formation to trachea
- oesophageal perforation

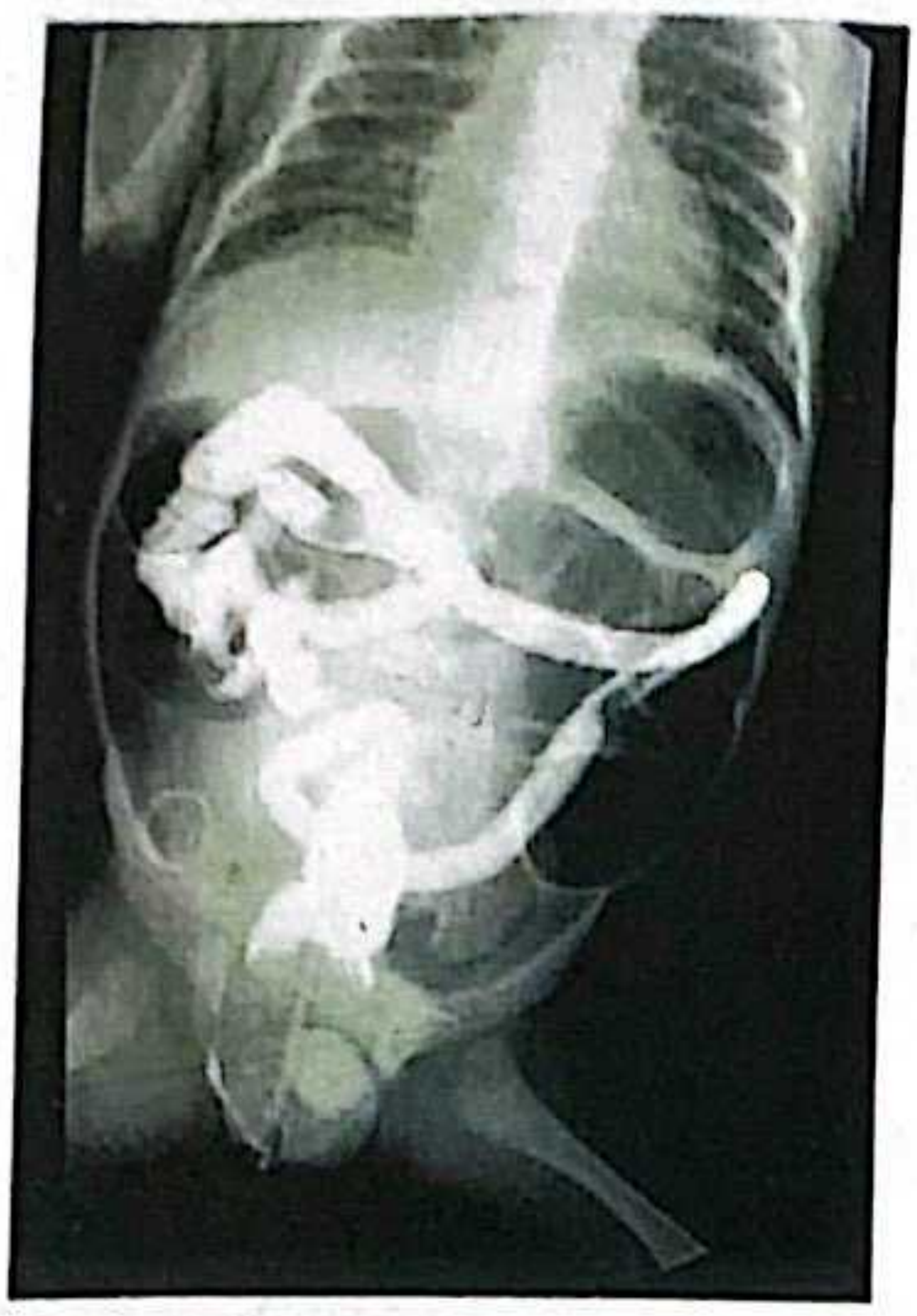
Treatment and prognosis

- Endoscopic mucosal resection, without or with localised ablation is an option for localised (T1a) disease.
- For T1b tumours and above, surgical options are mostly limited to oesophagectomy

Differential diagnosis

- benign tumours of oesophagus
- oesophageal leiomyoma
- oesophageal leiomyomatosis
- non-malignant conditions (e.g. diffuse inflammation)

Q.10) Premature child with failure to pass meconium, abdominal distension and vomiting-AGE: 3 days-Male (2015)



Identify: Barium Enema Spot image on Fluoroscopy

Describe: There is marked dilatation of small bowel loops. Contrast enema reveals small entire colon with radiolucent filling defects representing meconium seen scattered at right colon and distal ileum.

Diagnosis: Meconium ileus

What next: Ultrasound

Prenatal ultrasound findings associated with meconium ileus include

- echogenic bowel, which can be dilated and thick walled
- polyhydramnios
- fetal ascites
- peritoneal wall calcifications
- intra-abdominal cysts

Treatment and prognosis

Water-soluble contrast enema usually clears the impacted meconium, with a success rate of over 60%.

Complications

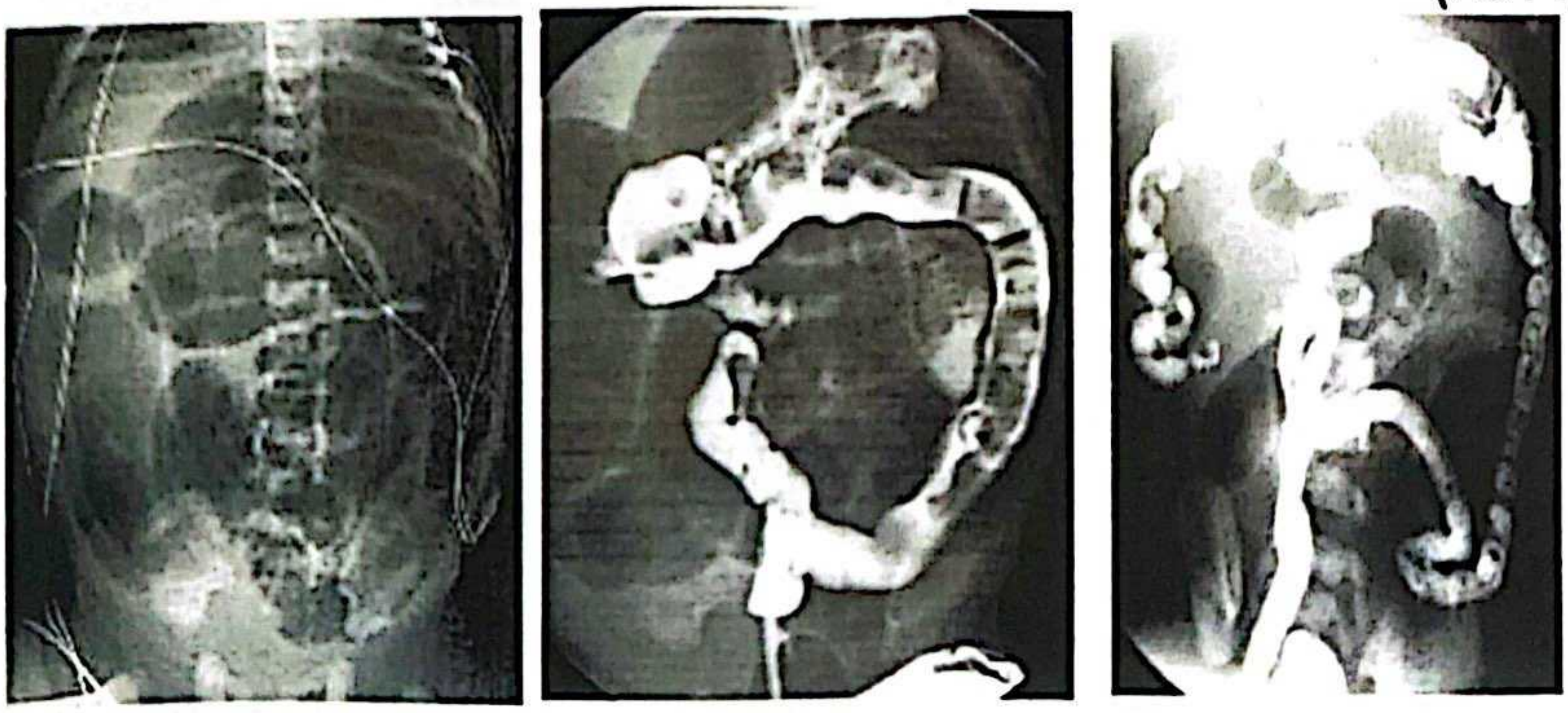
- ileal atresia or stenosis
- ileal perforation resulting in meconium peritonitis
- volvulus with or without pseudocyst formation

Differential diagnosis

- total colonic Hirschsprung disease
- meconium plug syndrome

Q.11) Failure to pass meconium. -AGE: 3 days-Male

(2014)



Identify: Abdominal x-ray and contrast enema spot image fluoroscopy

Describe: multiple loops of dilated bowel proximal to a colon packed with retained meconium.

Diagnosis: Features are consistent with meconium plug syndrome.

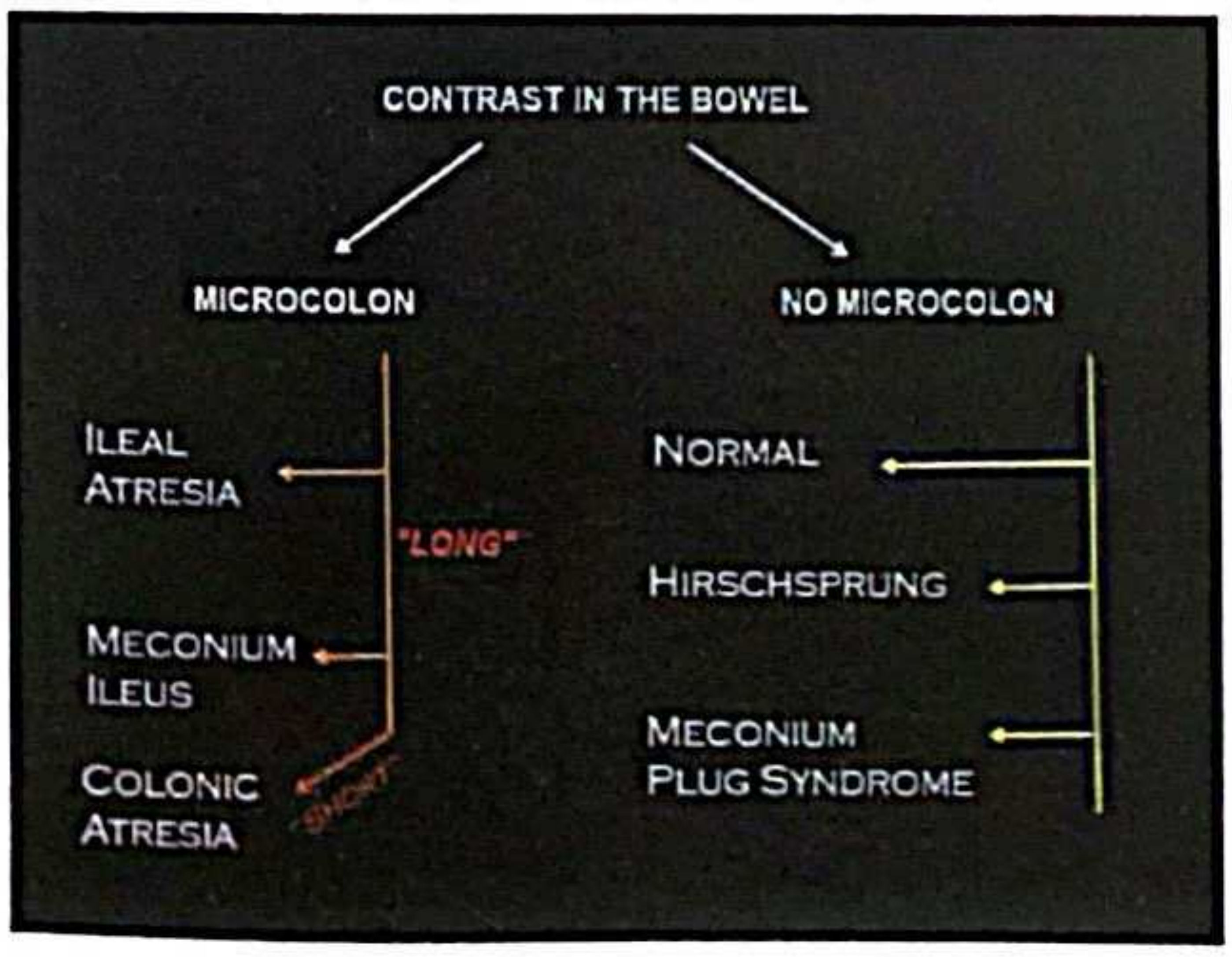
What next: Treatment and prognosis

Usually, resolves with time. Initial nonsurgical management includes rectal stimulation and contrast enema

Differential diagnosis

On a plain radiograph consider most other causes of bowel obstruction. On a contrast enema consider:

- meconium ileus (right colon usually not dilated)
- long segment Hirschsprung disease (often has a reversed recto-sigmoid ratio)
- ileal atresia (on contrast enema)



CONTRAST IN THE BOWEL

MICROCOLON

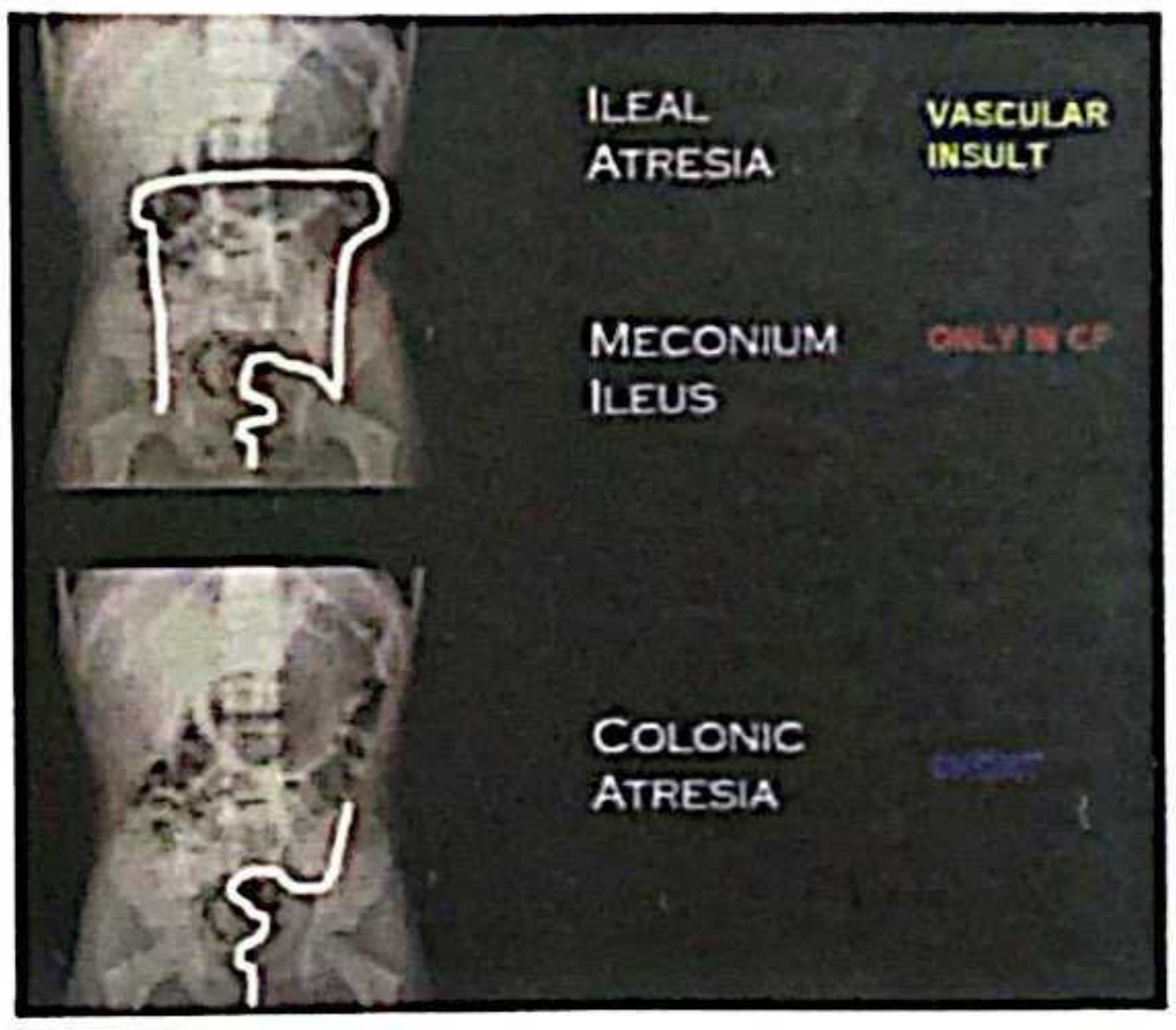
- ILEAL ATRESIA
- MECONIUM ILEUS
- COLONIC ATRESIA

"LONG"

SHORT

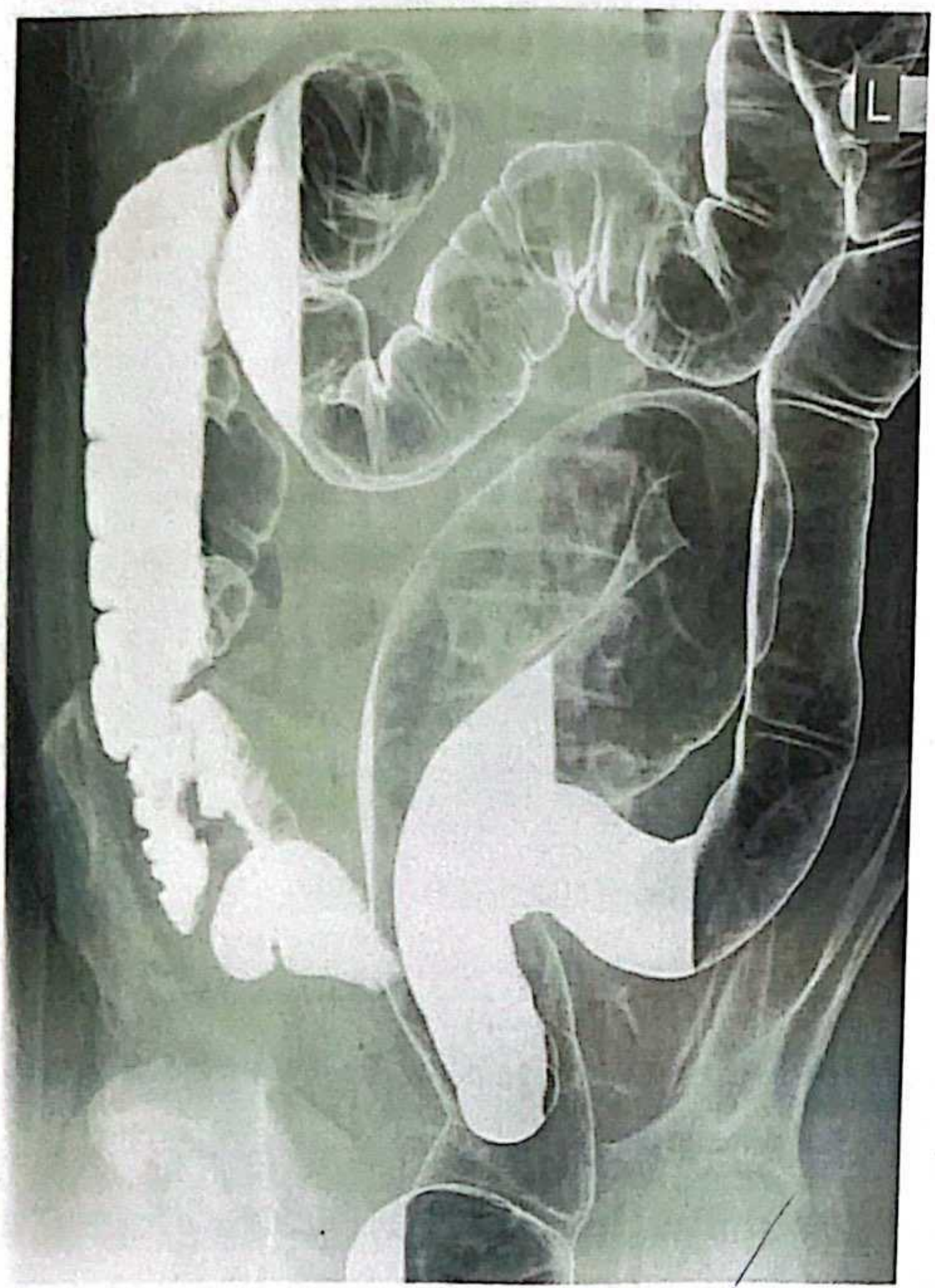
NO MICROCOLON

- NORMAL
- HIRSCHSPRUNG
- MECONIUM PLUG SYNDROME



Q.12) Diarrhea and per rectum bleeding- Adult-Male

(2013)



Identify: Double contrast barium enema spot image flouroscopy

Describe: A featureless descending and sigmoid colon, lacking normal haustral marking. There are no stenoses or masses. No evidence of fistula formation.

The ascending and transverse colon appear normal with preserved normal haustral folds. The terminal ileum is distended and normal in appearance.

Diagnosis: Ulcerative colitis (Lead Pipe Bowel)

What next: CT will reflect the same changes that are seen with a barium enema, with the additional advantage of being able to directly visualise the colonic wall, the terminal ileum and identify extra-colonic complications, such as perforation or abscess formation. It is important to note however that CT is insensitive to early mucosal disease. Inflammatory pseudopolyps may be seen if large enough, in well distended bowel. In areas of mucosal denudation, abnormal thinning of the bowel may also be evident.

A cross section of the inflamed and thickened bowel has a target appearance due concentric rings of varying attenuation, also known as mural stratification. In chronic cases, fat submucosal deposition is seen particularly in the rectum (fat halo sign). Also in this region, extramural deposition of fat, leads to thickening of the perirectal fat, and widening of the presacral space. Strictures are also common and are not all malignant. These are predominantly due to marked muscularis mucosa hypertrophy, which is also in part responsible for the lead pipe sign. Colorectal carcinoma is often sessile. Focal loss of mural stratification or excessive mural thickness (1.5 cm) should prompt endoscopic evaluation

Treatment and prognosis

Total colectomy is curative of both the intestinal symptoms and of the potential risk of colorectal carcinoma. Medical therapy is able in some cases to control the colonic disease but does not remove the need to carefully and regularly screen for malignancy.

Differential diagnosis

- infective colitis
- pseudomembranous colitis
- ischaemic colitis
- radiation colitis

Q: What two complications of this disease are most dreaded?

A: Colorectal cancer and toxic megacolon.

Q: Name some of the mucoasl changes seen in this condition (not in this case)?

A: Pseudopolyps, button-shaped ulcers, filiform hyperplastic polyps.

Q: What features would suggest a maligant stricture?

A: Heaped up edges, mural thickening >1.5 cm, shouldering and mucosal destruction.

Associations

- primary sclerosing cholangitis (PSC)
- moya moya phenomenon
- ankylosing spondylitis
- colorectal carcinoma

Extra-intestinal manifestations

- thoracic manifestations of ulcerative colitis
- uveitis and iritis
- erythema nodosum and pyoderma gangrenosum
- thrombotic complications
- fatty liver
- seronegative spondyloarthropathy

Plain film:

- Hyperplastic mucosa, polypoid mucosa, deep ulcers
- **Diffuse dilatation with loss of haustral markings**
- Toxic megacolon
- Free intraperitoneal gas
- Complete absence of fecal residue (due to inflammation)

BE:

Acute stage

- Narrowing+ incomplete filling (spasm+ irritability)
- Fine mucosal granularity = stippling of barium coat (from diffuse mucosal edema + hyperemia +superficial erosions)
- Spicules + serrated bowel margins (tiny superficial ulcers) "collar button" ulcers(= undermining of ulcers)
- Double-tracking" = longitudinal submucosal ulceration over several
- Hazy/fuzzy quality of bowel contour (excessive secretions)
- "thumbprinting" = symmetric thickening of colonic folds
- Pseudopolyps = scattered islands of edematous mucosa
- Reepithelialized granulation tissue within areas of deudanal mucosa
- Widening of presacral space
- Obliterated rectal folds= valves of Houston (43%)

Although colonoscopy is relatively safe in acute ulcerative colitis, the air enema can assess the entire colon more rapidly, and with less discomfort and probably with less risk

Subacute stage

- Distorted irregular haustra
- Inflammatory polyps= sessile frond like
- Pedunculated lesions (= localized mucosal inflammation resulting in polypoid protuberance)
- Coarse granular mucosa (= mucosal replacement by granulation tissue)

Chronic stage

- Shortening of colon(= reversible spasm of longitudinal muscle) with depression of flexures
- "leadpipe" colon = rigidity + symmetric narrowing of lumen
- Widening of haustral clefts I complete loss of haustrations (DDx: cathartic colon)

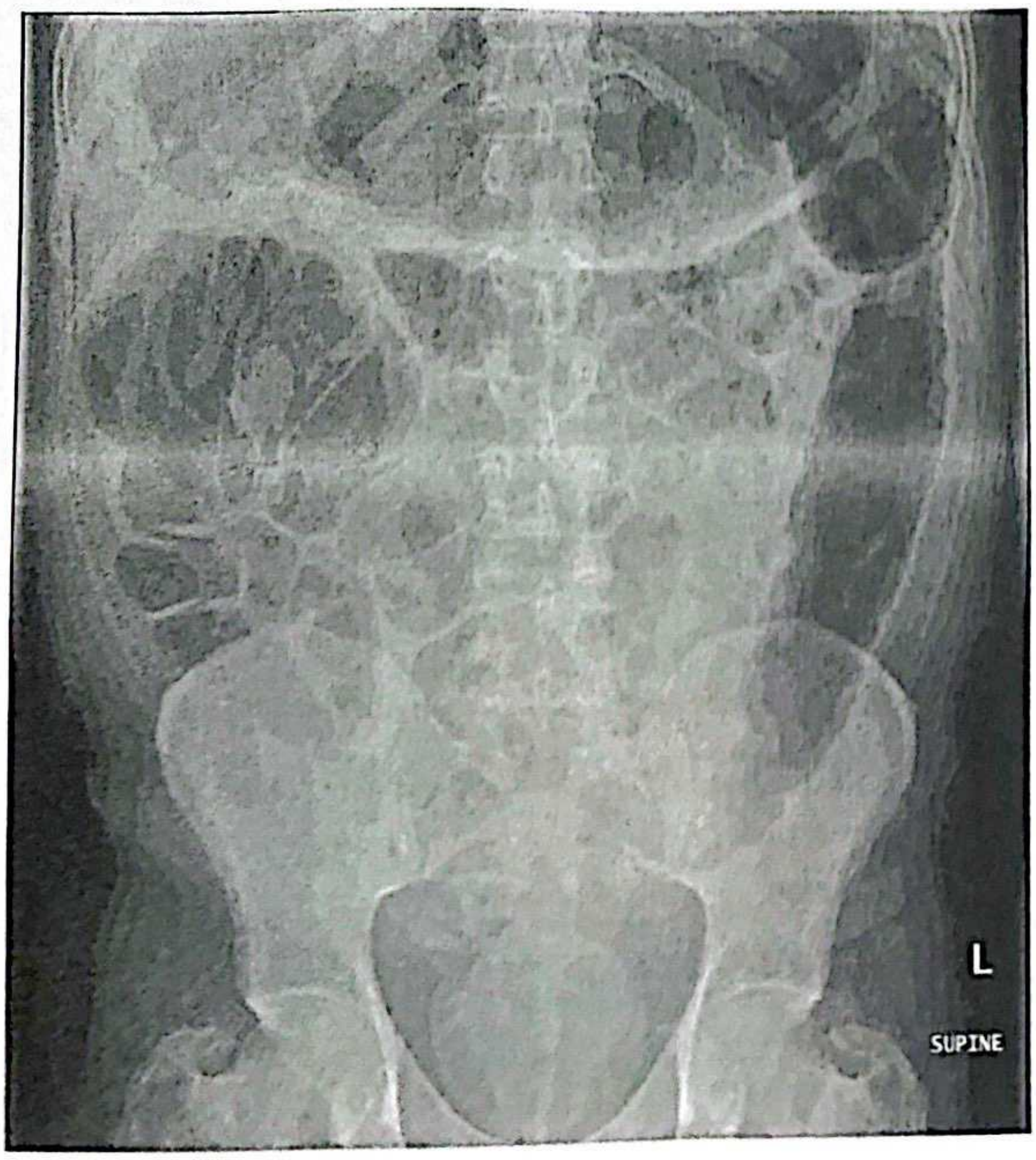
- "burnt-out colon" =fairly distensible colon without haustral markings + without mucosal pattern
- Hazy/fuzzy quality of bowel contour (excessive secretions)
- Post inflammatory polyps (12-19%) =small sessile
- Nodules I long wormlike branching + bridging out growths (= filiform polyposis)
- "backwash ileitis" (5-30%) involving 4-25 em of
- terminal ileum with patulous ileocecal valve+ absent peristalsis + granularity

CT/MR:

- Wall thickening 3.5-11.6 mm (normal <3 mm;Indeterminate = 3-4 mm; pathologic >4 mm)
- Submucosal stripe =enhancement of mucosa but not submucosa
- **Free air will be most apparent in either the erect or left lateral decubitus positions xray, but CT remains the procedure of choice to exclude this; as little as I ml can be detected when scans are viewed on the appropriate imaging**

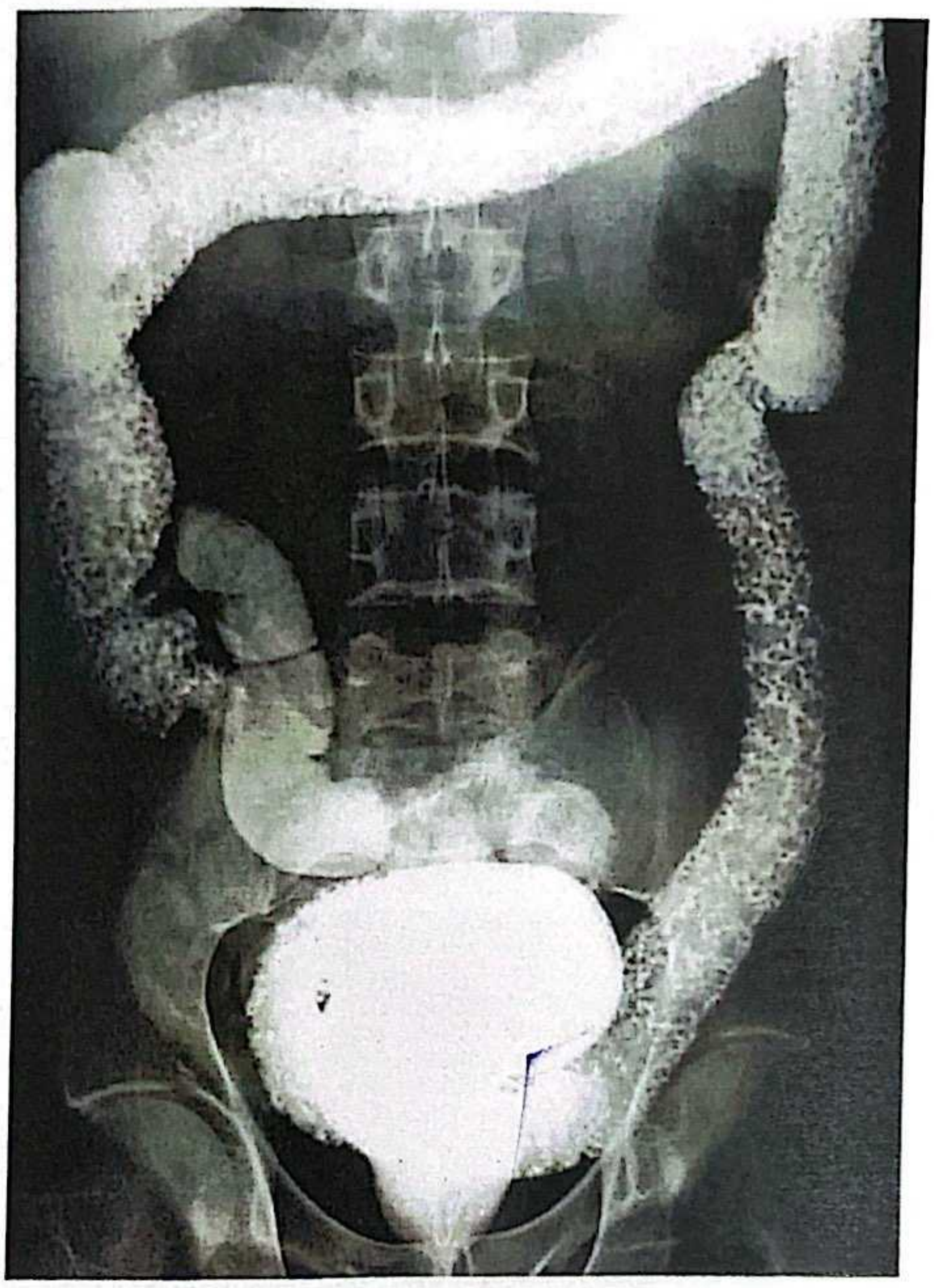
NUC:

- Positive on Tc-99m hexamethylpropyleneamine (HMPAO)-labeled leukocytes



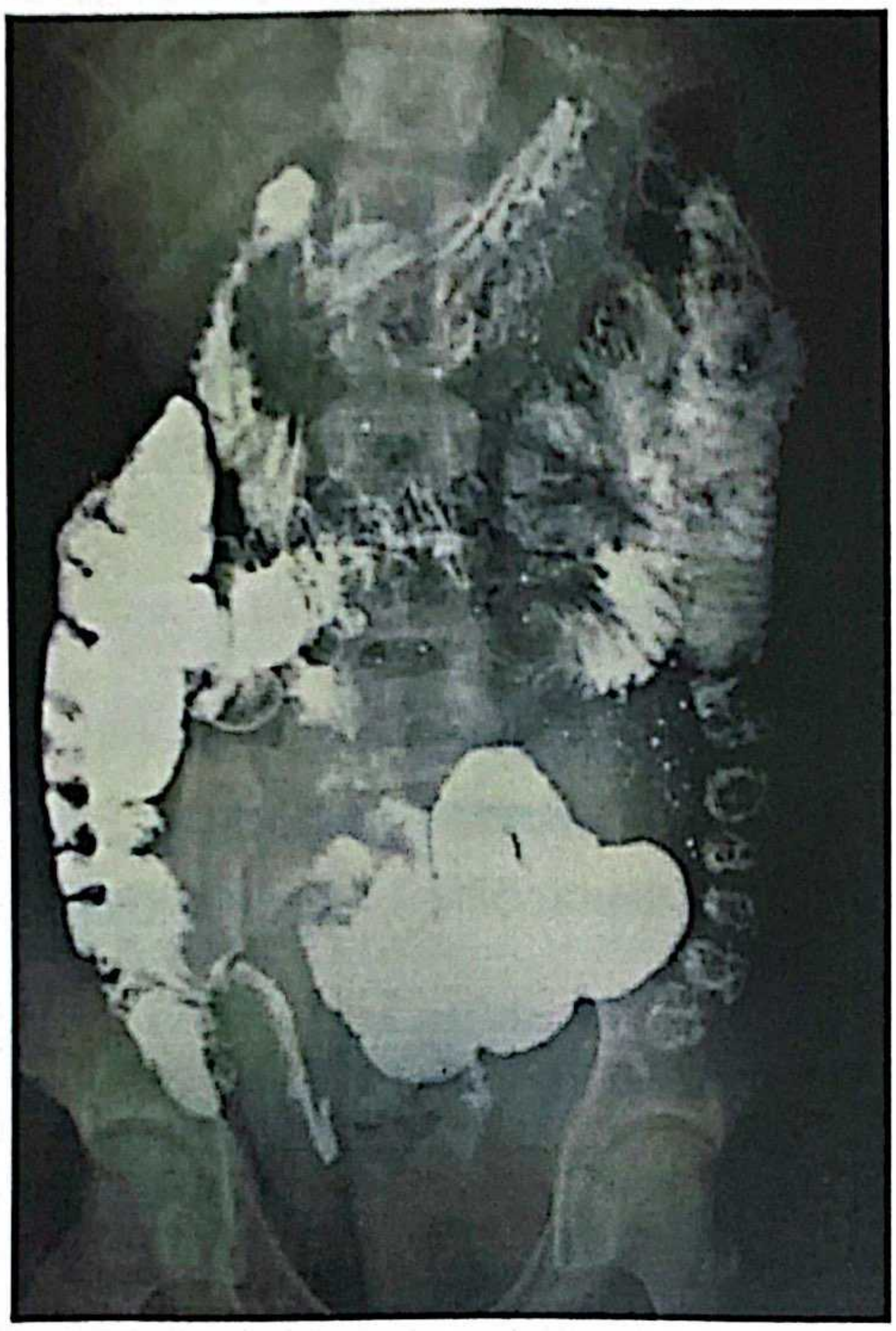
Plain radiograph of Ulcerative colitis (Lead Pipe Bowel) Non-specific findings but may show evidence of mural thickening (more common), with thumbprinting also seen in more severe cases.

Dilated transverse colon noted. The abdomen demonstrates markedly dilated transverse colon (9 cm) with impression of slight dilatation of the descending colon with some" thumb printing" in the wall (consistent with mucosal inflammation in the clinical circumstances). No free subphrenic gas is seen.



The whole colon, without skips is affected by an irregular mucosa with loss of normal haustral markings.
Continuous lesion without skip,or carpeting of the whole colon is classic for ulcerative colitis.
Mucosal inflammation causes a granular appearance to the surface of the bowel. As inflammation increases, the bowel wall and haustra thicken. Mucosal ulcers are undermined (button-shaped ulcers). When most of the mucosa has been lost, islands of mucosa remain giving it a pseudo-polyp appearance.

Q.13) Recurrent abdominal pain with irritable bowel alternating constipation and diarrhea-AGE: 32-Male (2014)



Identify: Barium small bowel follow-through on fluoroscopy

Describe: Thickened bowel folds (oedema) with prominent involvement of the duodenum

Diagnosis: Crohn disease, idiopathic inflammatory bowel disease (IBD), Regional enteritis

What next: CT and MR enteroclysis are similar in sensitivity for active inflammation (89% vs 83% respectively) and both are somewhat better than small bowel follow-through (67-72%) 6. The lack of ionising radiation from MRI would make it a better option, however the availability of MRI is limited in many countries.

Treatment and prognosis

Management is complex as the condition is chronic with a relapsing-remitting course. Medical management includes corticosteroids, 5-ASA preparations, immunomodulation (e.g. azathioprine, cyclosporine, methotrexate).

Surgical management is reserved for complications including:

- **strictures**
- **adhesions and bowel obstructions**

- **fistulae**
- **perianal disease**

Differential diagnosis

When terminal ileitis is the main presentation, then differentials (adjusted for patient's age) include:

- acute appendicitis
- Yersinia ileitis
- mesenteric adenitis
- ileocaecal tuberculosis
- malignancy

When colonic involvement is the predominant feature then other considerations include:

- ulcerative colitis
- acute diverticulitis
- acute epiploic appendagitis
- ischaemic colitis
- pseudomembranous colitis
- infectious colitis.

Imaging Features:

Types of lesions

- Thickening of folds (edema)
- Nodular pattern (submucosal edema and inflammation)
- **String sign:** tubular narrowing of intestinal lumen (edema, spasm, scarring)
- **Omega sign:** asymmetric wall involvement results in contracture and C-shaped loop
- **Ram's horn sign:** loss of antral fornices with progressive narrowing from antrum to pylorus
- **Ulcerations:** Aphthoid ulcers are early lesions and correspond to mucosal erosions (pinpoint ulcer in edematous mound up to 3 mm in diameter and 2 mm in depth).
- **Filiform polyposis:** thin, elongated, branching mucosal lesions
- **Sinus tracts and fistulas** originate in fissures or deep ulcers; **characteristic of Crohn disease** at advanced stages.
- Fatty thickening along mesenteric border (creeping fat)

- Fibrosis and scarring may result in: **Pseudodiverticula** (fibrosis develops eccentrically)

Spatial arrangement of lesions

- Transitional zones are typical; they occur between involved bowel loops and normal bowel.
- Skip lesions are typical: discontinuous involvement of bowel
- **Lesions appear preferentially at mesenteric side of intestine.**

CT Findings:

Primary intestinal findings

- **Bowel wall thickening**

Normally <3 mm if well distended

Mean diameter in Crohn disease: 10 mm, If >10 mm, include pseudomembranous,
ischemic, or CMV colitis in differential diagnosis.

- Circumferential submucosal low attenuation surrounded by higher outer attenuation: **Halo sign**
- Inner and outer layers surrounding low-attenuation middle layer: **target sign**; middle layer of fat density; chronic, middle layer of water density Peri bowel inflammation ("dirty fat," "ground glass")

Mesentery

- Fat accumulates on serosal surfaces **("creeping fat")**
- Inflamed mesentery fat (stranding, "misty")
- Adenopathy in small bowel mesentery common
- Comb sign: vasa recta stretched out along one wall of colon

Extra intestinal findings:

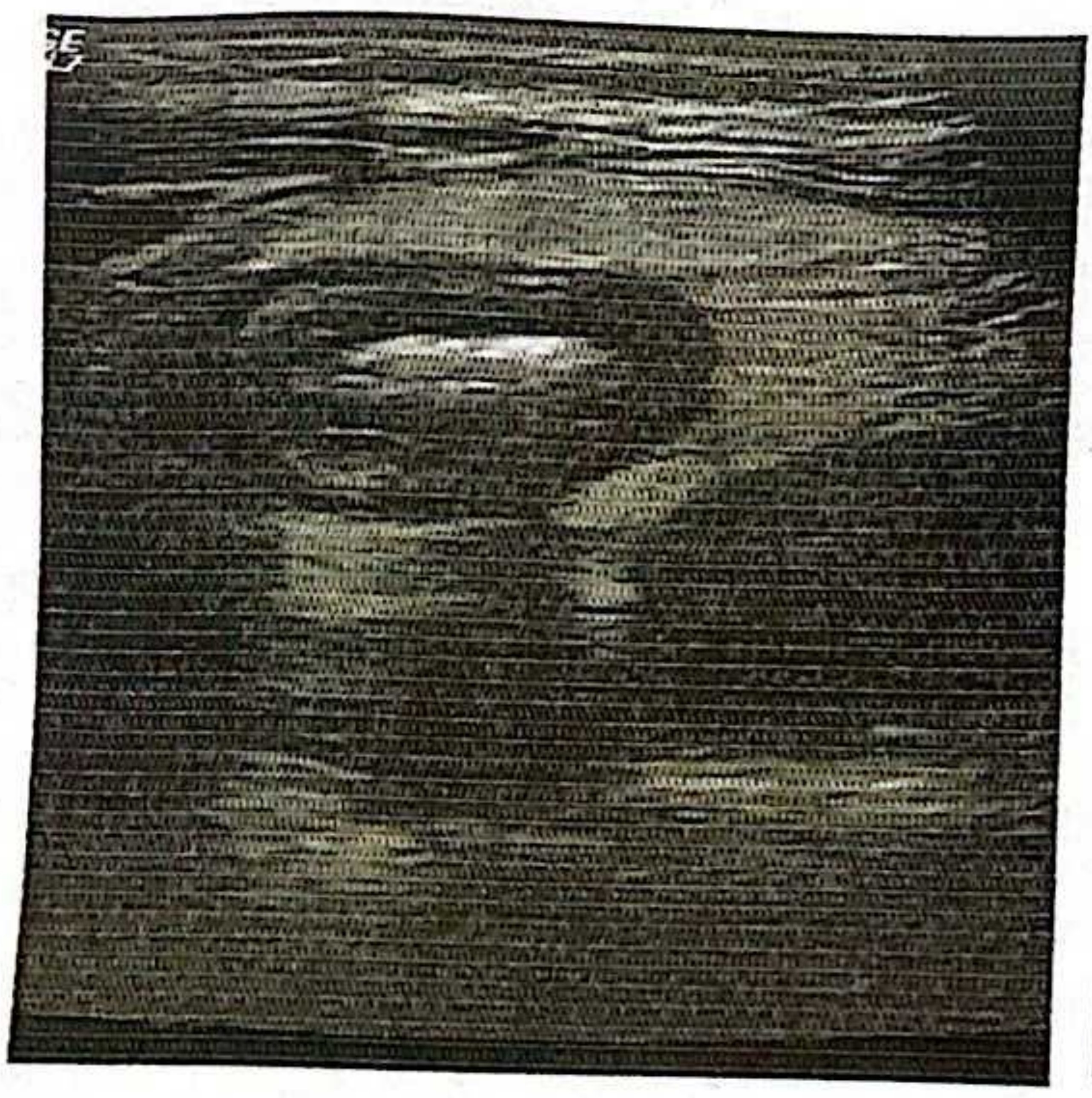
- Gallstones
- Osseous complications (may cause pain)
  - Spondylitis
  - Sacroiliitis
  - Steroid complications: osteomyelitis, osteoporosis,avascular necrosis
- Renal stones, 7%

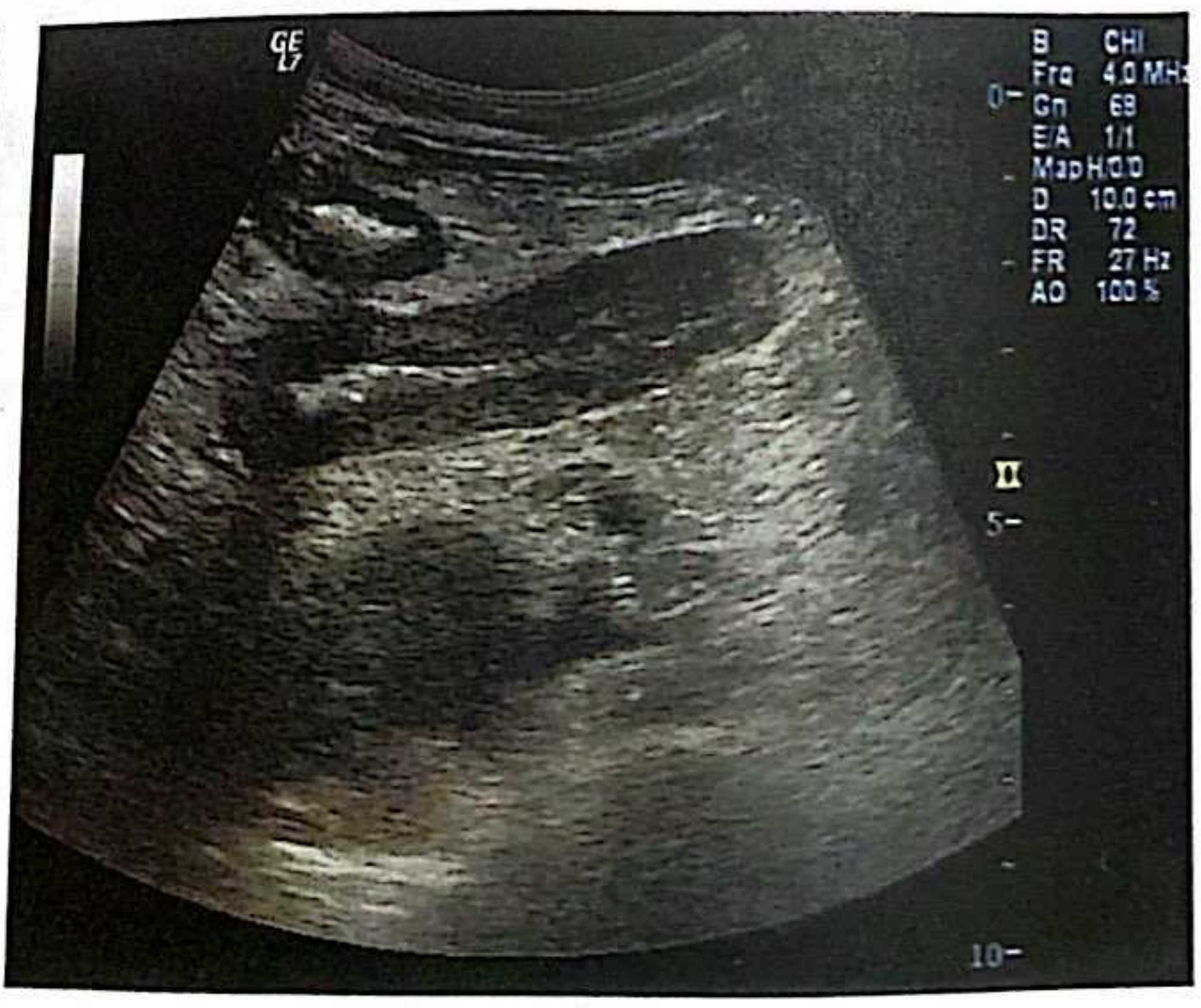
Pathologic development of lesions: initial event →hyperplasia of lymphoid tissue in submucosa →lymphedema → aphthoid ulcerations → deeper ulcers → fistulas, abscesses → strictures

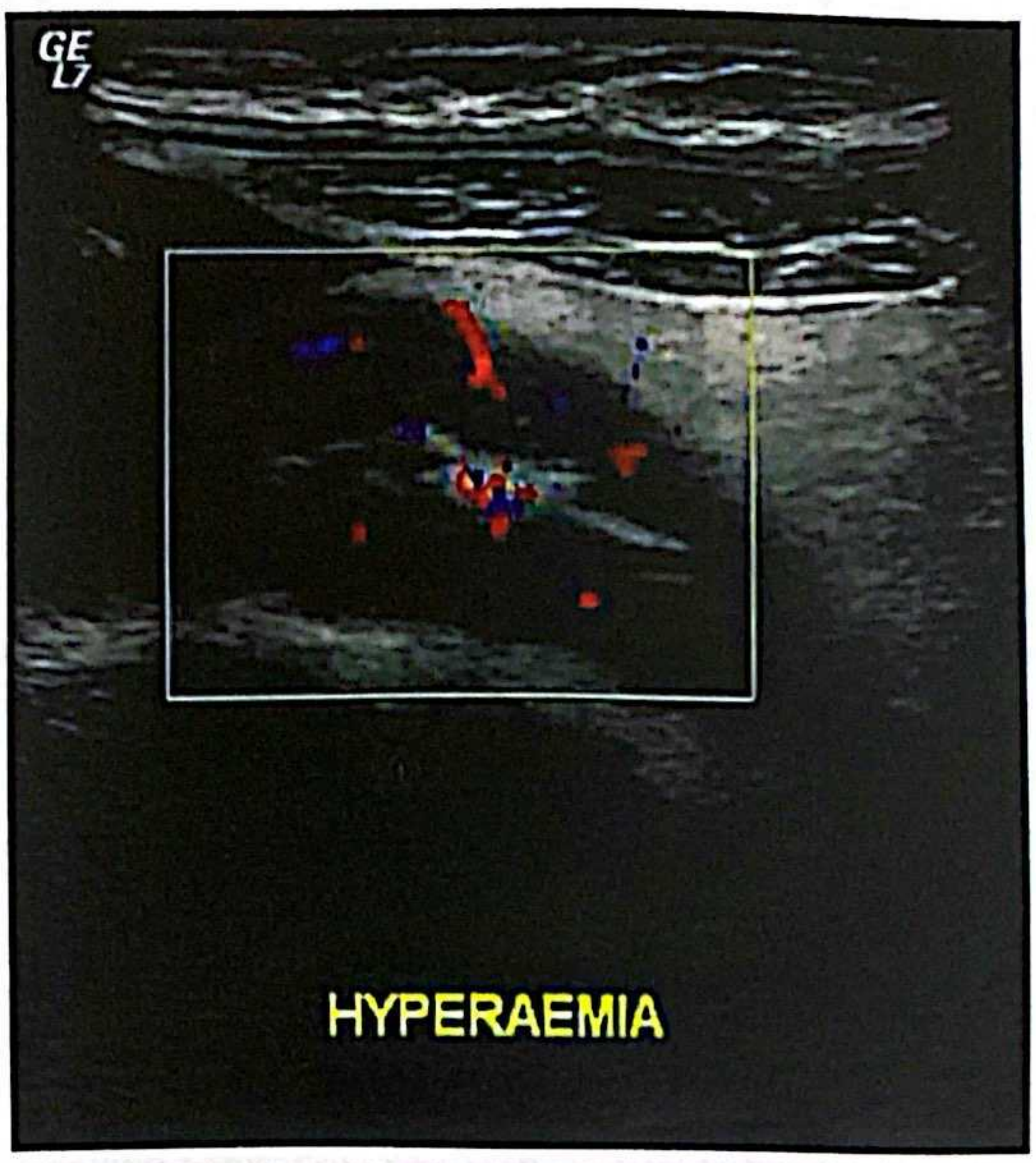
CROHNS	ULCERATIVE COLITIS
Slightly less common in the USA	Slightly more common
Discontinuous "Skips"	Continuous
Terminal Ileum - String Sign	Rectum
Ileocecal Valve "Stenosed"	Ileocecal Valve "Open"
Mesenteric Fat Increased "creeping fat"	Perirectal fat increased
Lymph nodes are usually enlarged	Lymph nodes are NOT usually enlarged
Makes Fistula	Doesn't Usually Make Fistula

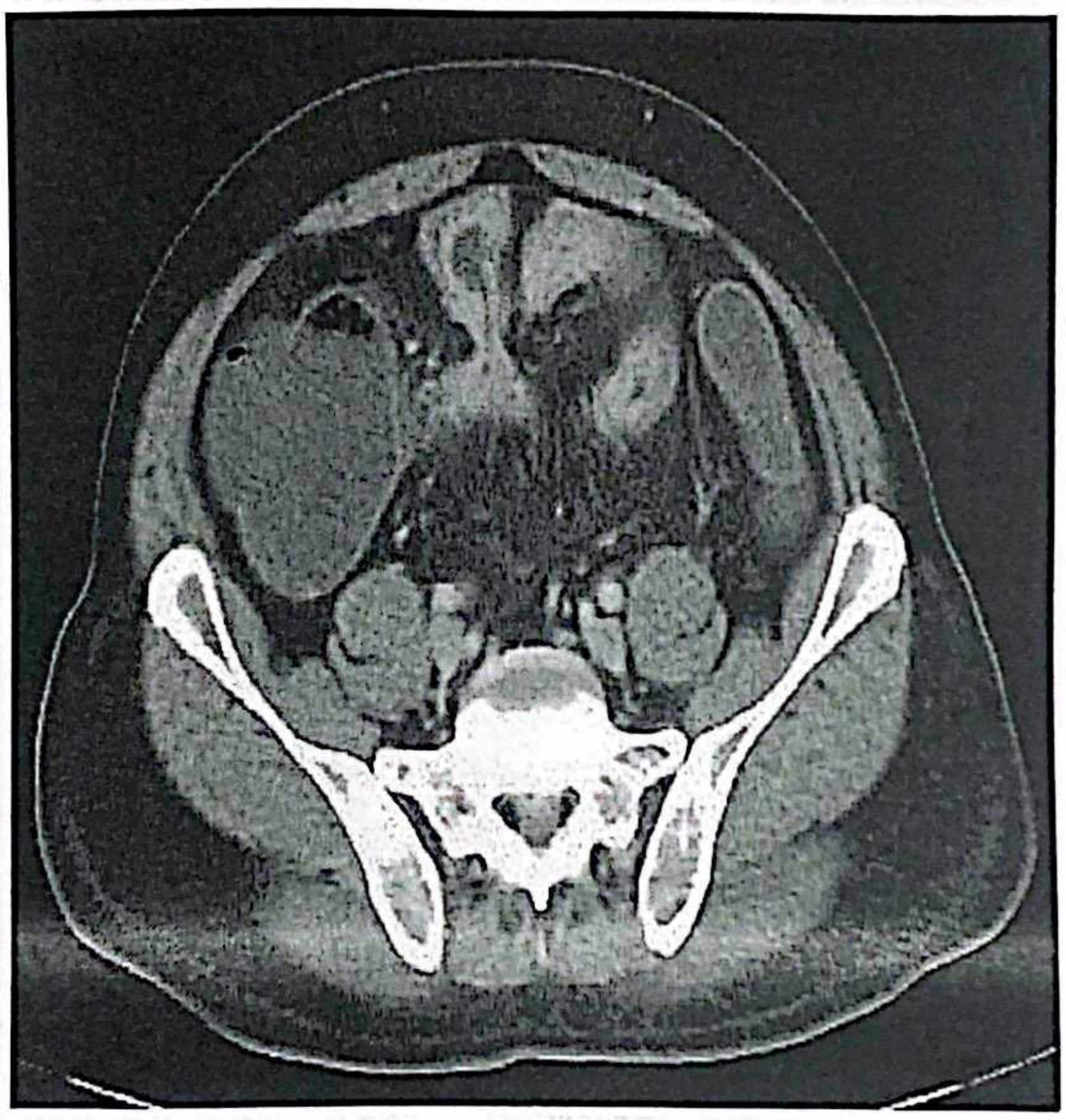
The terminal ileum is thickened measuring 5.5 mm in single wall thickness and shows target sign on transverse scan. Doppler examination reveals hyperaemia. There is background of mesenteric fatty infiltration, enlarged lymph nodes, mild intraperitonal fluid and other scattered bowel loops affected to a lesser degree but not continuous (skipped)

The clinical and ultrasonographic findings are highly suggestive of inflammatory bowel disease particularly crohn's disease in activity. The patient was referred to upper GI contrast study, CT and laboratory investigation



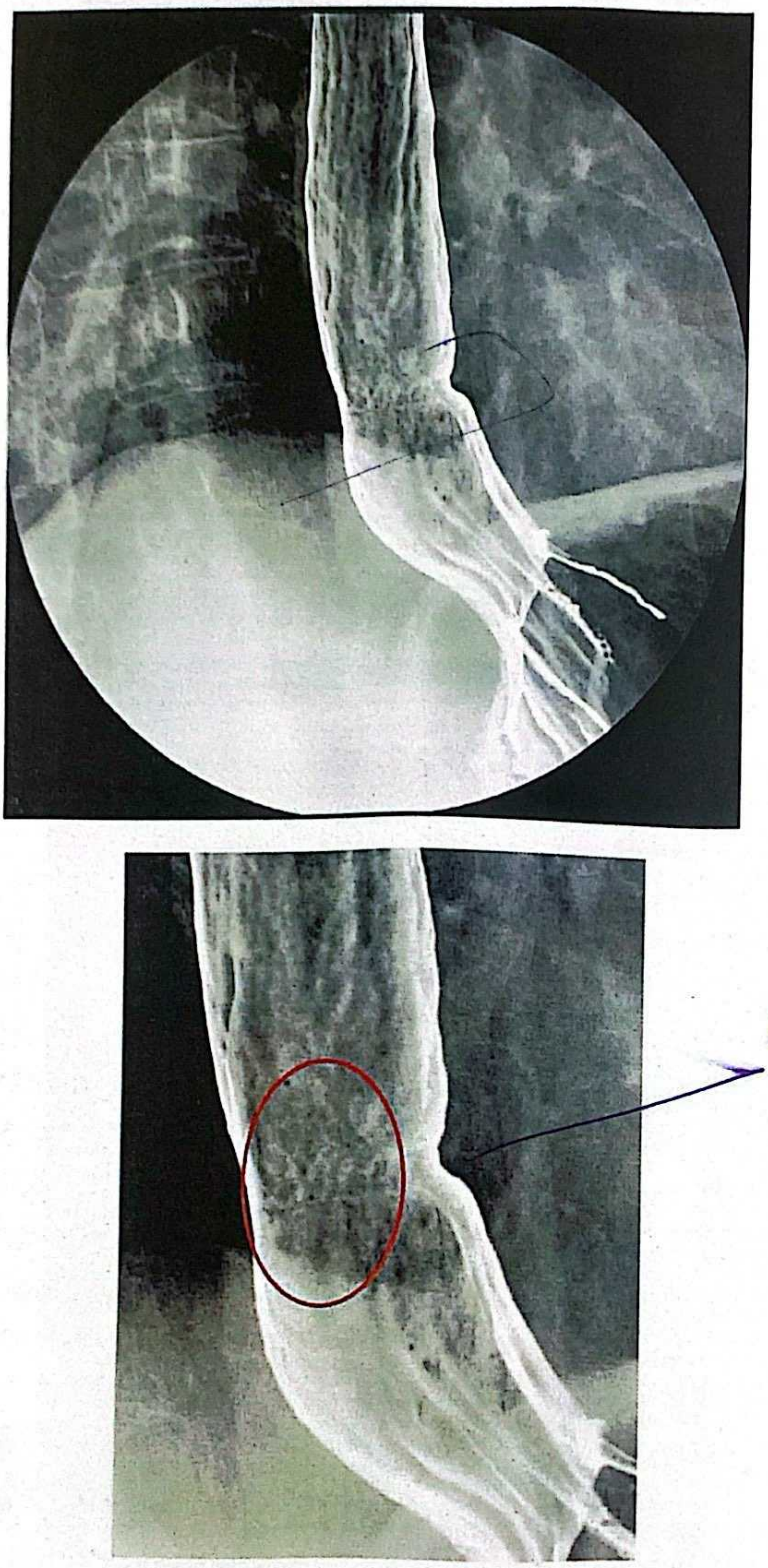






Long segment circumferential mural thickening and stratification involving terminal ileum with engorged vasa rectae (Comb sign), mesenteric fatty proliferation. Nipple like projection from superior margin of terminal ileum with a fistuluous track to another inflamed loop of terminal ileum. No abdominal collections. No free peritoneal air.

Q.14) Long history of symptomatic gastro-oesophageal reflux, with heartburn and regurgitation-AGE: 55-60Y—Female (2013)



GEJ
Barrett esophagus

Zoomed-in images of the fine reticular pattern superimposed on oesophagitis (fine granular pattern) found in Barrett oesophagus. The area of fine reticulation is either circled in red or pointed to with red arrows.

Identify: Double-contrast oesophagram barium swallow
Describe: There is background granularity to the normal smooth-as-glass appearance of the oesophagus, compatible with reflux oesophagitis.
That's not all there is, though... at the gastro-oesophageal junction, there is a fine reticular pattern superimposed on the granularity.
Diagnosis: This pattern is concerning for Barrett oesophagus
What next: Endoscopy with biopsy

Fluoroscopy Double-contrast oesophagogram
Signs of reflux oesophagitis

- reflux
- long stricture in the mid or lower oesophagus
- large deep solitary ulcer
- fine reticular mucosal pattern
- thickened irregular mucosal folds
- earliest signs of developing adenocarcinoma: localised flattening, stiffening, or irregularity in the wall of a stricture
- There is a 70% chance of Barrett oesophagus in a midthoracic oesophageal stricture.

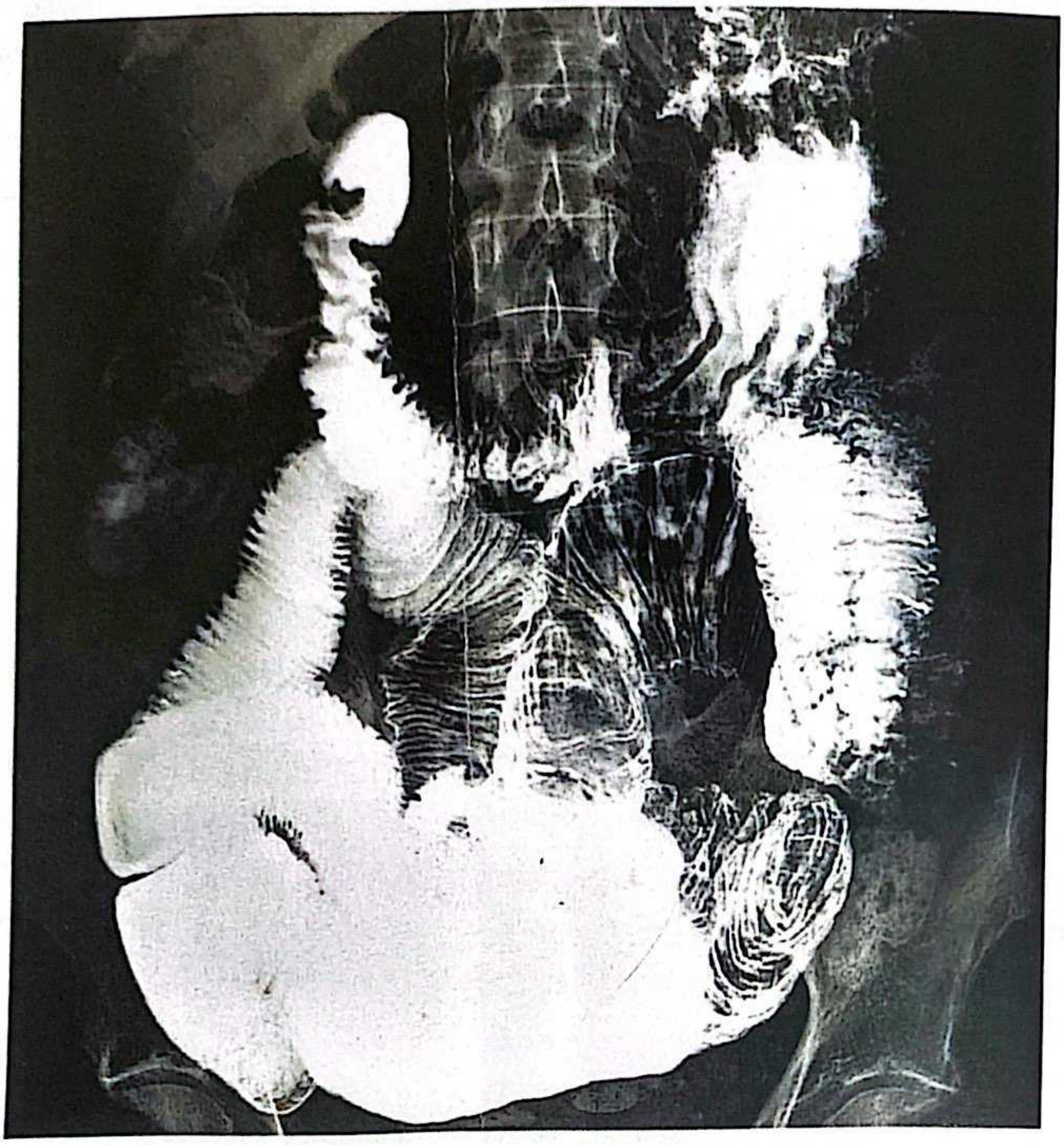
Treatment and prognosis
Since Barrett oesophagus is considered a premalignant lesion, confirmation with upper endoscopy and biopsy is warranted.
If Barrett oesophagus is confirmed on biopsy, then aggressive therapy for gastro-oesophageal reflux is pursued, and perhaps endoscopic surveillance, depending on the patient's age and other risk factors.
One surveillance and biopsy protocol suggest:

- low-grade dysplasia: 6-12 months
- high-grade dysplasia: 3 months
- If there is mucosal irregularity (what would be seen on an oesophagogram), then endoscopic resection has been recommended.
- Prophylactic resection or ablation has been used by some, particularly in younger patients.

Complication:
(1) Ulceration ±penetration into mediastinum
(2) Stricture
(3) Adenocarcinoma

Q.15) Long standing abdominal bloating and malabsorption.Adult-Female

(2014)



Identify: Barium follow-through of the small bowel

Describe: Generalised bowel dilatation with closely approximated valvulae conniventes which are of normal thickness despite dilatation of the bowel lumen.

No strictures / stenoses or masses are visible and the mucosa is otherwise normal.

Diagnosis: Scleroderma small bowel involvement

Differential diagnoses

- sprue: segmentation, flocculation, hypersecretion
- small bowel obstruction
- pseudo-obstruction
- adult Hirschsprung disease

Complications

- aspiration
- oesophagitis:

- mucosal erosion
- fusiform stricture ~4-5cm above the gastro-oesophageal junction
- progression to Barrett oesophagus
- higher risk of development of oesophageal cancer (adenocarcinoma)

Barium sulfate

Contraindications

1. known or strongly suspected gastrointestinal perforation
2. may be used in evaluation for possible oesophageal perforations, see below
3. large volume aspiration
4. prior allergic reaction
5. left-sided colonic obstruction (relative contraindication)
6. if the barium cannot exit the colon, it has the potential to become inspissated and very hard, leading to a quite problematic constipation

Abnormal collection of barium anywhere (mnemonic)

FEDUP

Mnemonic

FEDUP

F: fistula
E: extravasation
D: diverticulum
U: ulcer
P: perforation

Normal oesophageal contours on barium swallow

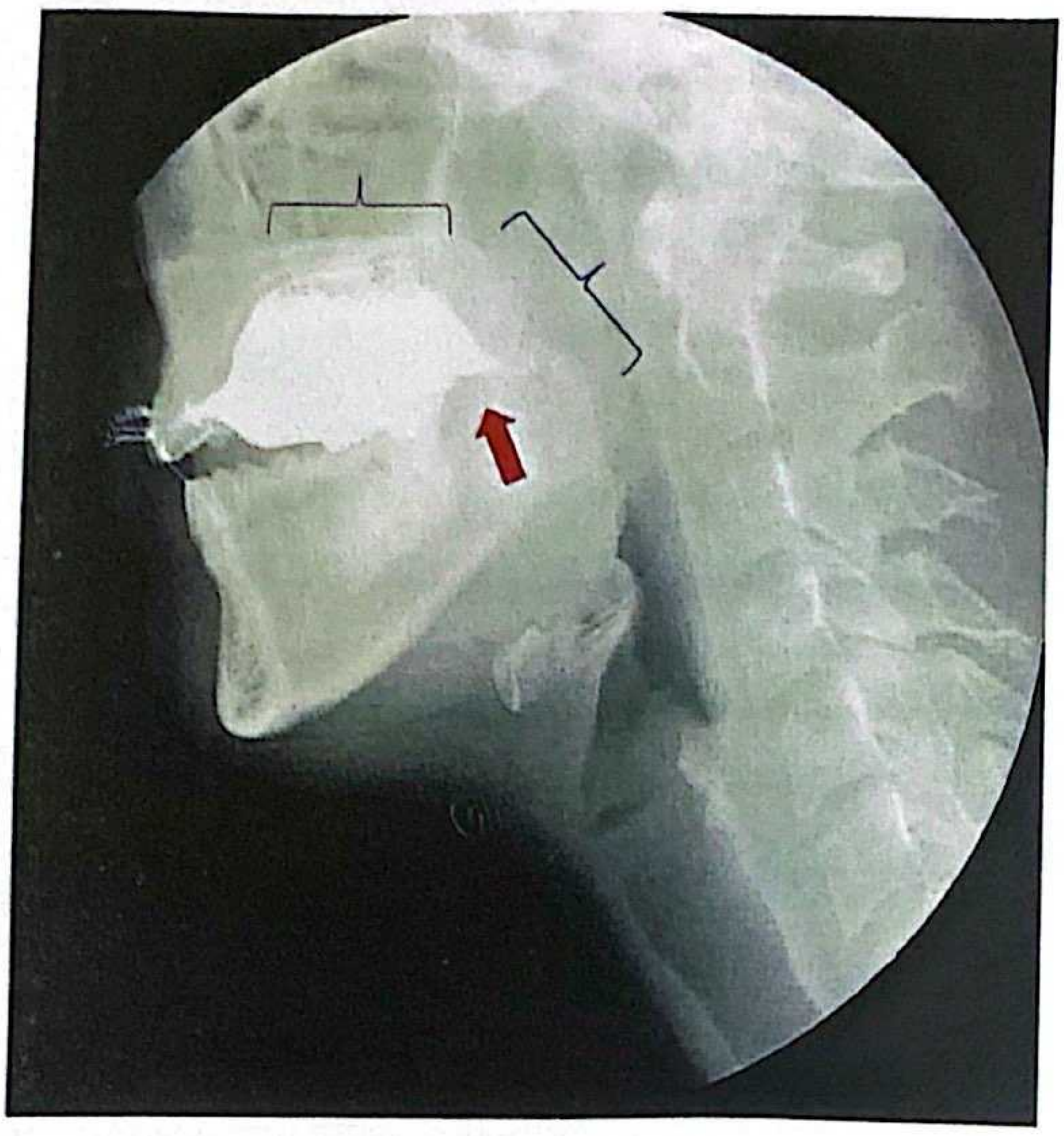
There are a number of normal oesophageal contours or impressions that are encountered when performing a barium swallow. It is important to be able to differentiate normal contours and their variants, as well as contours that may indicate disease. Below is a list of anatomical structures that may be seen in a normal barium swallow:

- cricopharyngeus muscle (cricopharyngeal bar)
- aorta
- left main bronchus
- left atrium

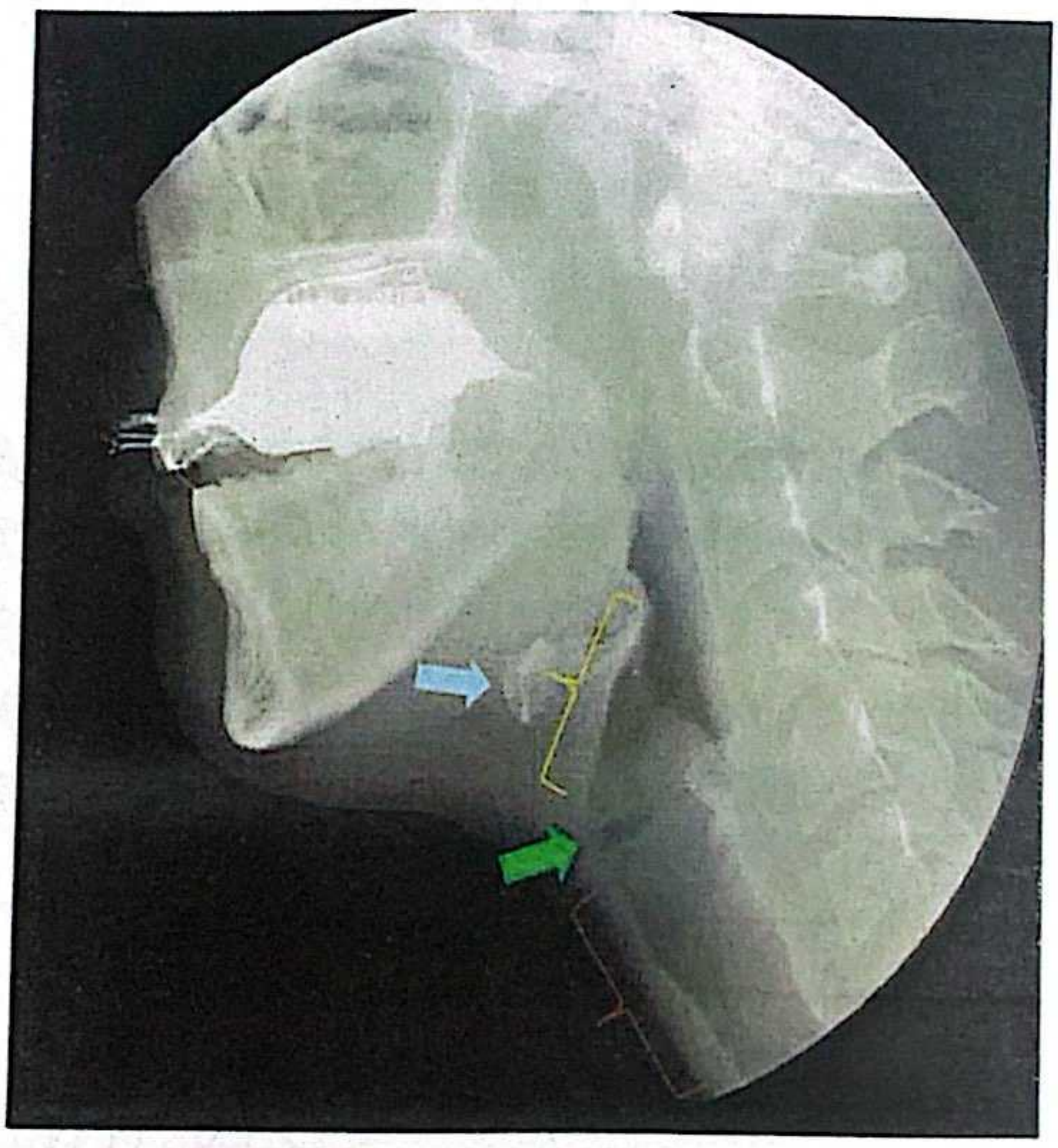
AMB
A

Anatomical variants

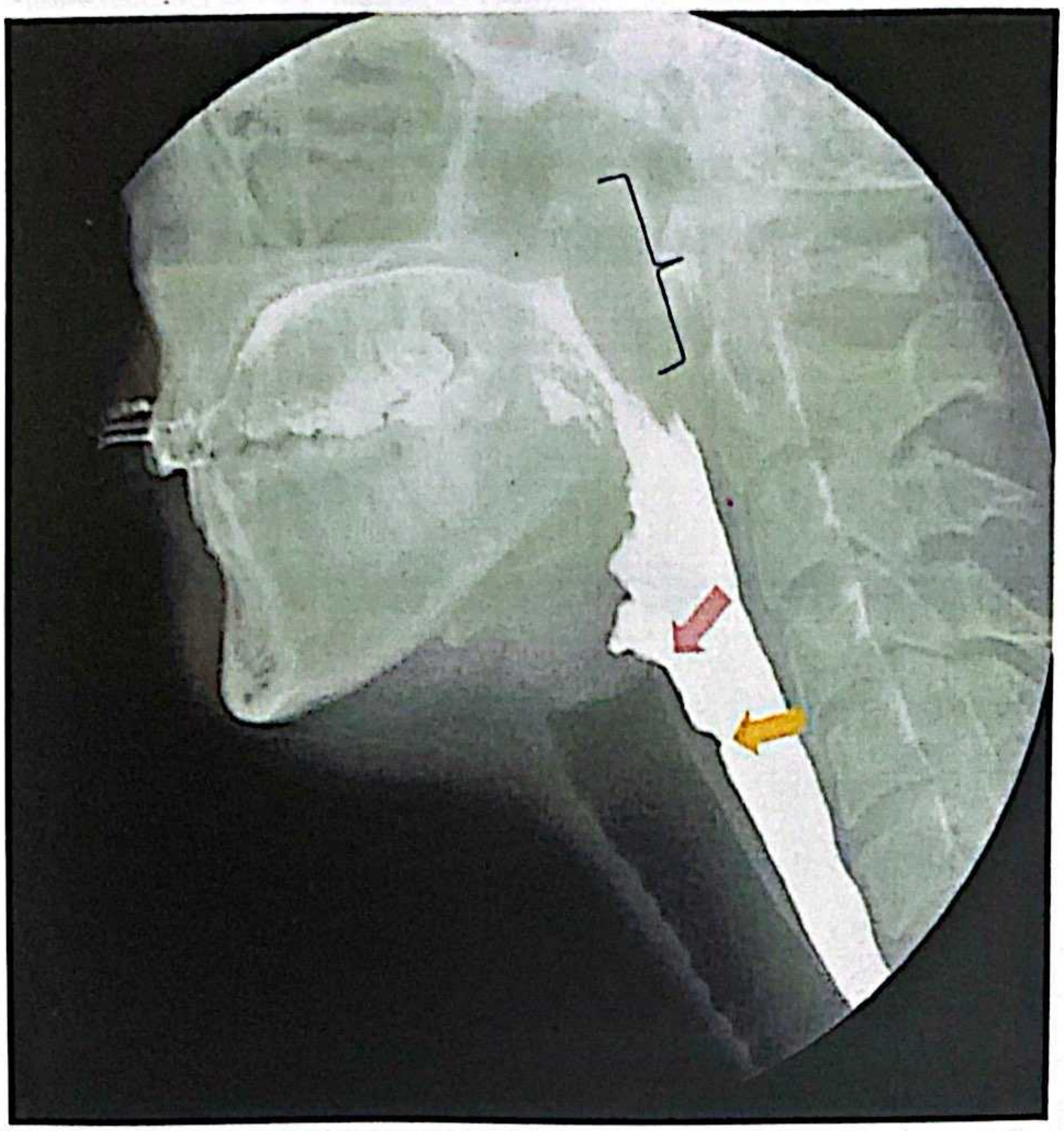
- aberrant right subclavian artery (arteria lusoria)
- aberrant left pulmonary artery



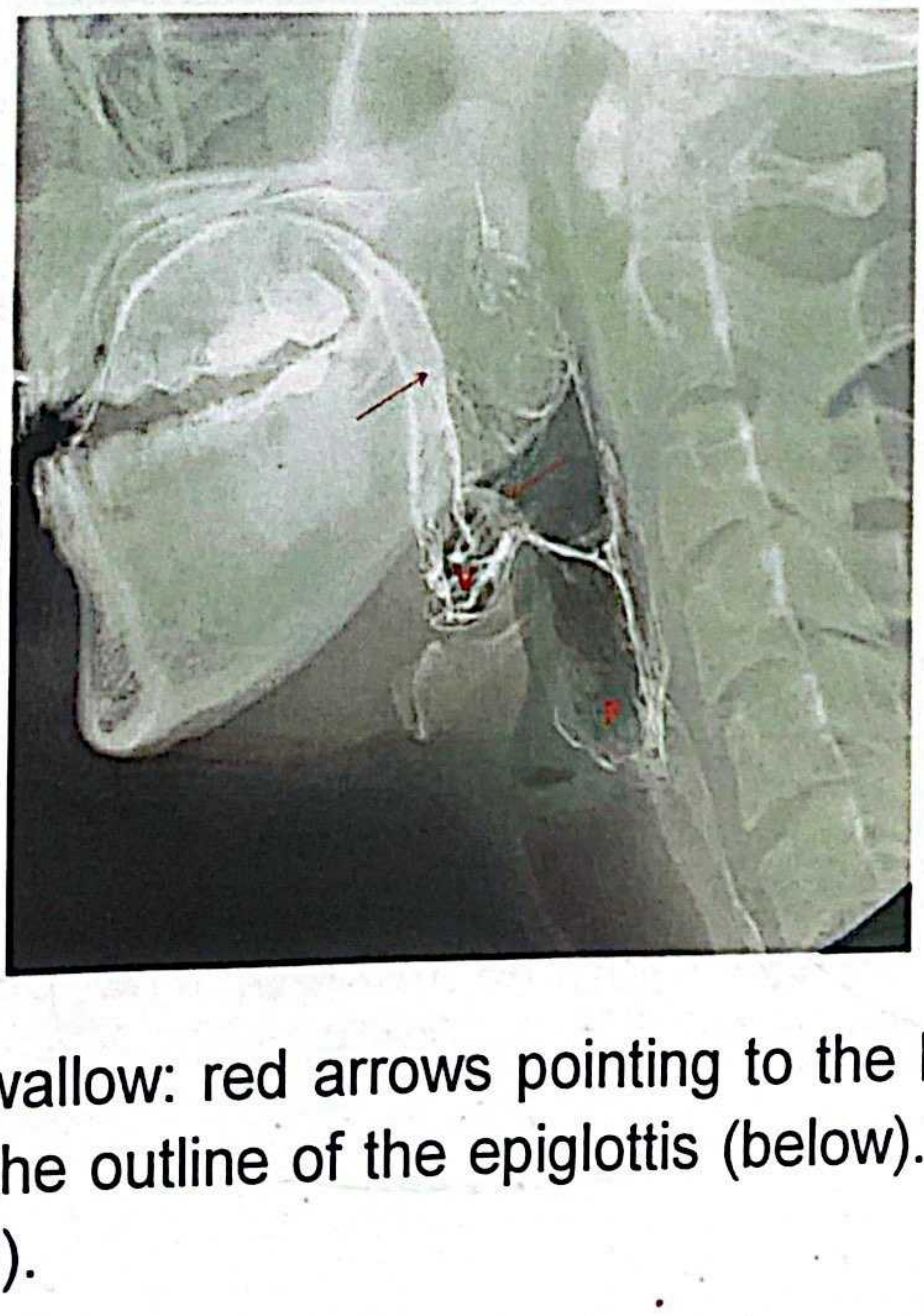
Oral phase: base of tongue (red arrow) apposed to the soft palate (dark blue bracket). There is no premature spillage into the pharynx. The hard palate is demarcated by the purple bracket.



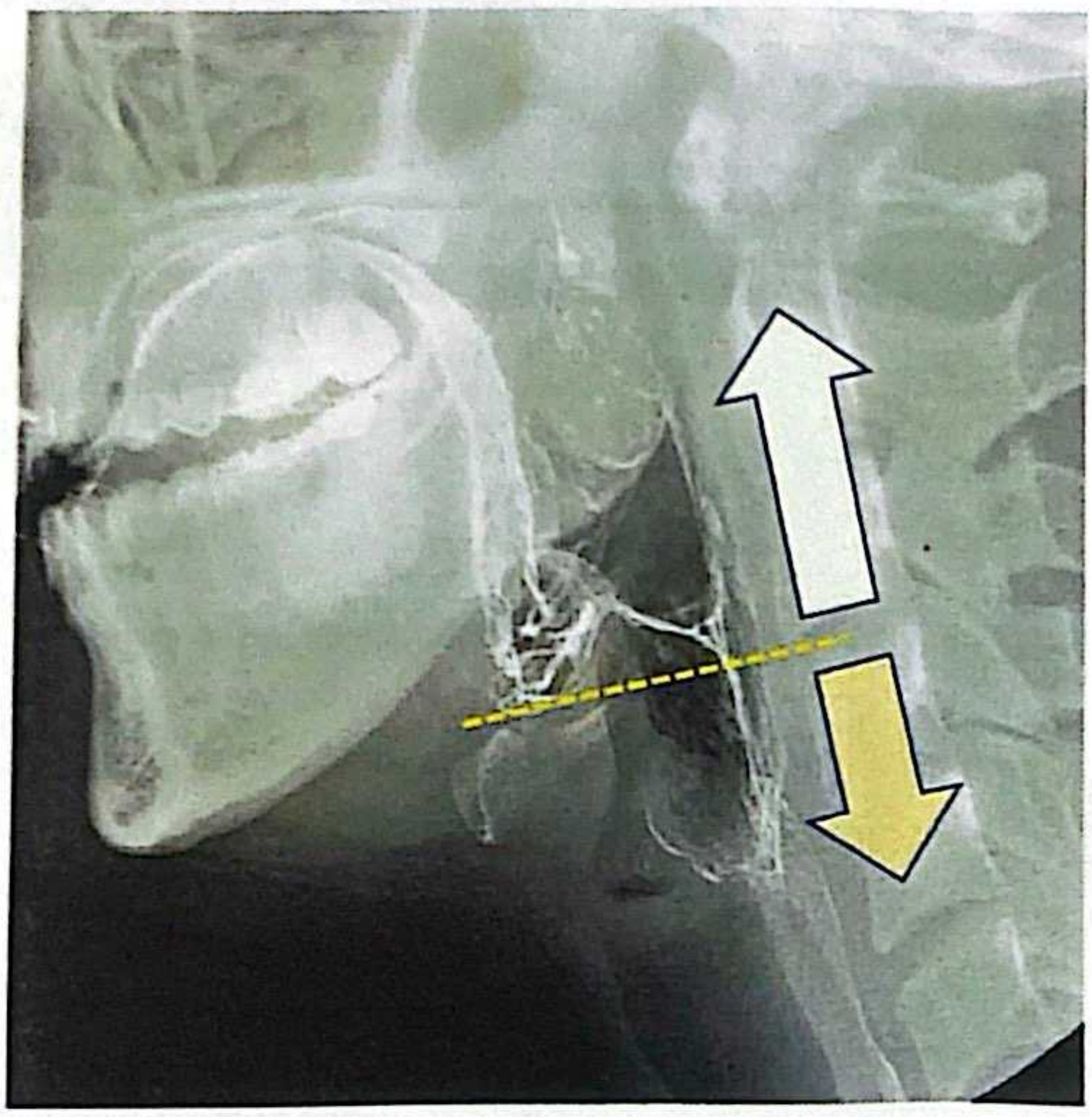
Oral phase, normal anatomy: hyoid bone (blue arrow), laryngeal vestibule/aditus (yellow bracket), air in the laryngeal ventricle between the true and false vocal cords (green arrow), proximal trachea (red bracket).



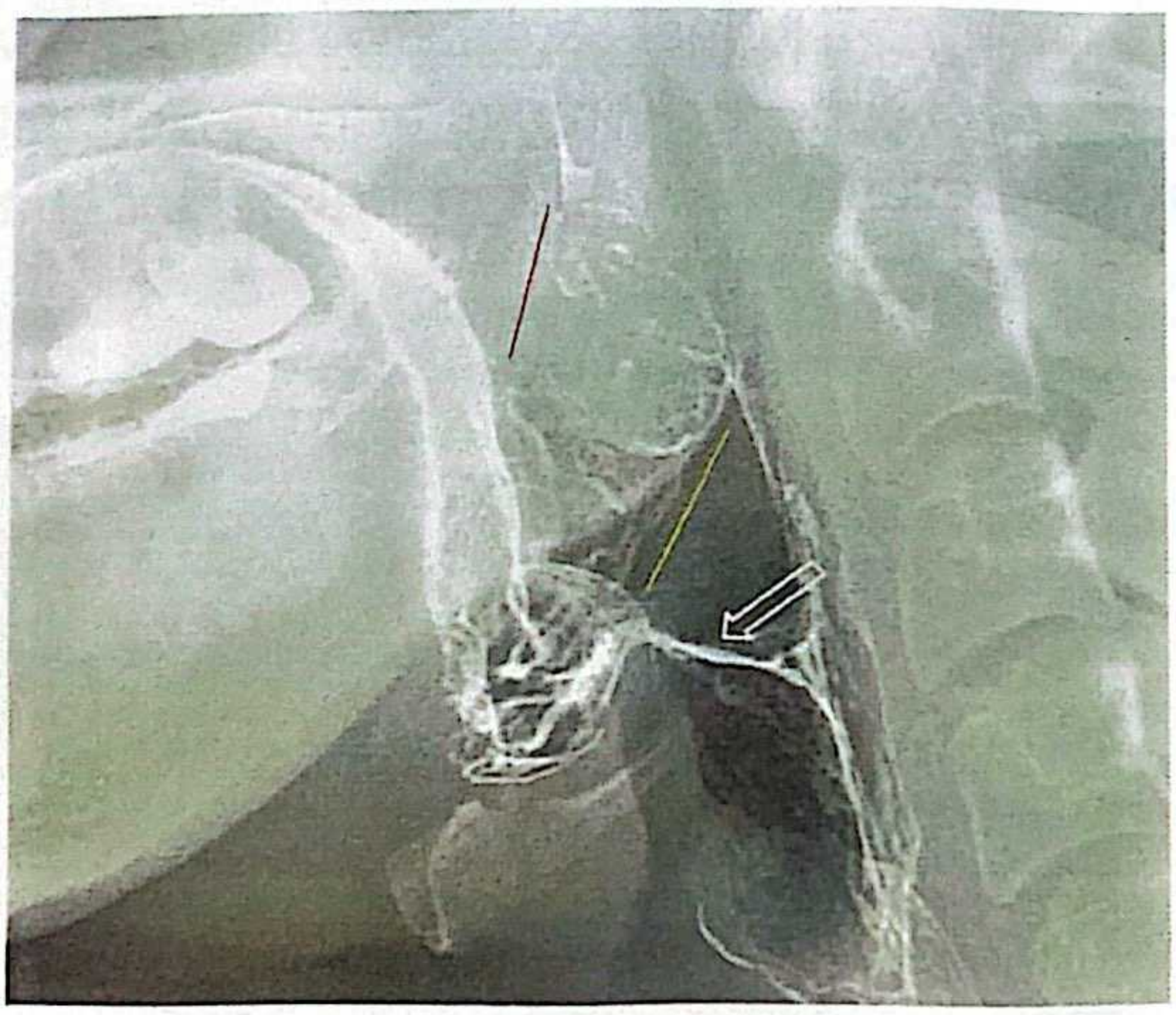
Pharyngeal phase: Normal epiglottic tilt (pink arrow), normal submucosal venous plexus (orange arrow). Soft palate apposed to nasopharynx prevents nasopharyngeal reflux. Barium proceeds down the cervical oesophagus



After initial barium swallow: red arrows pointing to the base of the tongue (above) and the outline of the epiglottis (below). Valleculae (V). Pyriform sinus (P).



Division of the mesopharynx (above) and hypopharynx (below)



Red line parallels the faint palatoglossal fold. Yellow line parallels the faint stylopharyngeus muscle. The pink arrow points to the aryepiglottic folds.

CONTRAST SWALLOW (Also named Barium swallow when barium is used)

Indications – suspected oesophageal pathology

1. Dysphagia
2. Anaemia
3. Pain
4. Assessment of tracheo-oesophageal fistulae
5. Assessment of the site of perforation with gastrografin
6. Gastro-oesophageal reflux disease (GORD/GERD)
7. Assessment of a hiatus hernia
8. Generalised epigastric pain
9. Gobus hystericus
10. Persistent vomiting
11. Inability to pass the endoscope during UGIE

Contrast medium

1. E-Z HD 200–250% 100 ml (or more, as required)
2. **Iodide-based contrast agent if perforation is suspected (e.g.Conray, Gastrografin)**
3. LOCM (approx. 300mglml)

Gastrografin should NOT be used for the investigation of a tracheo-oesophageal fistula or when aspiration is a possibility.

BARIUM MEAL

Methods

1. Double contrast – the method of choice to demonstrate mucosal pattern.
2. Single contrast – uses: Children – since it usually is not necessary to demonstrate mucosal pattern
b. to demonstrate gross pathology only.

Indications

1. Failed upper gastrointestinal endosocpy
2. Dyspepsia
3. Weight loss
4. Upper abdominal mass
5. Gastrointestinal haemorrhage (or unexplained iron-deficiency anaemia)
6. Partial obstruction
7. Assessment of site of perforation – it is essential that a water-soluble contrast medium, e.g. Gastrografin or LOCM, is used.

Contraindications

Complete large-bowel obstruction.

Contrast medium

1. E-Z HD 250% w/v 135 ml
2. Carbex granules (double contrast technique).

Patient preparation

1. Nil orally for 6 h prior to the examination
2. It should be ensured that there are no contraindications to the pharmacological agents used.

BARIUM FOLLOW-THROUGH

Methods

1. Single contrast
2. With the addition of an effervescent agent
3. With the addition of a pneumocolon technique.

Indications

1. Pain
2. Diarrhoea
3. Anaemia/gastrointestinal bleeding
4. Partial obstruction
5. Malabsorption
6. Abdominal mass
7. Tumors
8. Swelling and/or inflammation of the small intestine walls

Contraindications

1. Complete obstruction. This may not be an absolute contraindication if the surgical team are aware of this.
2. Suspected perforation (unless a water-soluble contrast medium is used).
3. Conditions where aspiration of barium is likely

Contrast medium

E-Z Paque 100% w/v 300 ml usually given in 10–15-min increments,although some radiologists give the full 300ml at once. The transit time through the small bowel has been shown to be reduced by the addition of 10ml of Gastrografin to the barium.

In children, 3–4ml kg is a suitable volume.

In situations where barium is contraindicated, non-ionic watersoluble solutions have been shown to be a satisfactory alternative.

Patient preparation

Metoclopramide 20mg orally may be given before or during the examination.

Preliminary film

Plain abdominal film is used if small bowel obstruction is thought possible.

Films

1. Prone PA films of the abdomen are taken every 15–20 min during the first hour, and subsequently every 20–30 min until the colon is reached. The prone position is used because the pressure on the abdomen helps to separate the loops of small bowel.
2. Spot films of the terminal ileum are taken supine, using a compression pad.

Additional films

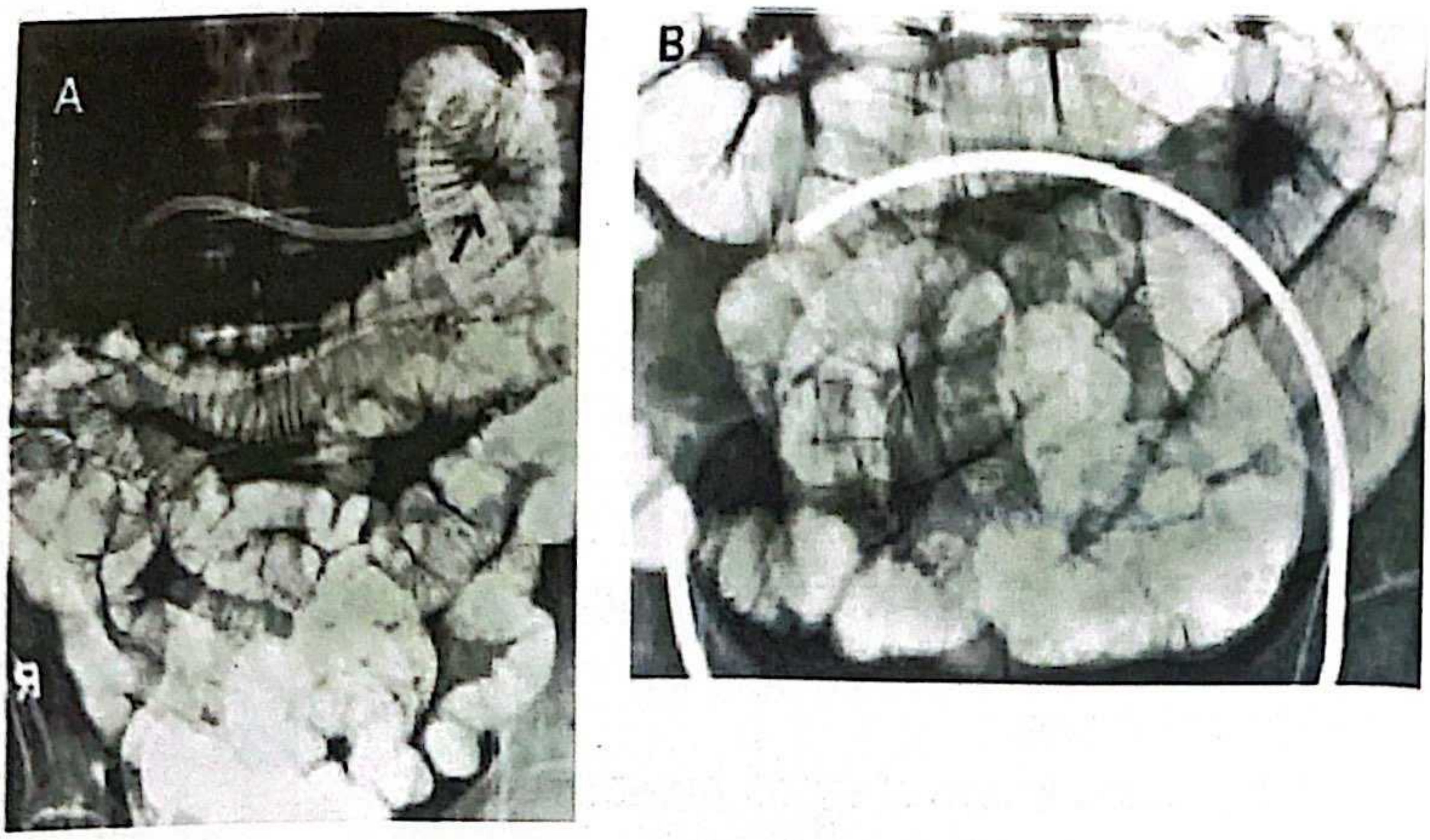
1. To separate loops of small bowel:
   a. compression with fluoroscopy
   b. obliques
   c. with X-ray tube angled into the pelvis
   d. with the patient tilted head down.
2. To demonstrate diverticula: erect film – this position will reveal any fluid levels caused by contrast medium retained within the diverticula.

Enteroclysis

- improved technique to show small bowel mucosal pattern with double contrast (air and oral contrast)
- a long tube is introduced and its tip is placed at the duodenojejunal angle and beyond
- a manageable pump is necessary for insufflation
- requires about 10 minutes or more fluoroscopy
- although the advantage of the technique is showing individual small bowel loops in great detail, increased radiation dose to the patient, and lack of the necessary tools for enteroclysis means it is not used routinely and it is often an academic technique

Double contrast imaging limited to the ileocaecal region

- at the moment when the oral contrast column from the ileum enter the caecum, introduce air by insufflation into the colon
- as the ileocaecal valve is patulous in 90% of people and air could easily enter the ileum, double contrast imaging is acquired for this region by this technique called peroral pneumocolon



(A) Large film of the abdomen from an enteroclysis examination of the small intestine. The small bowel is intubated with the tip of the tube (arrow) in the jejunum. Compared to the perioral examination, the small bowel loops are distended more fully, causing the mucosal folds to assume a transverse orientation. (B) Compression film (ring of balloon paddle) of the small bowel loops in the pelvis with the patient in a prone position. Although the loops are overlapped,the "see-through" effect using a dilute barium suspension permits their clear visualization.

SMALL-BOWEL ENEMA

Advantage

This procedure gives better visualization of the proximal small bowel than that achieved by a barium follow-through because rapid infusion of a large, continuous column of contrast medium directly into the jejunum provides better distension of the proximal small bowel. This is less effective in the ileum.

Disadvantages

1. Intubation may be unpleasant for the patient and may occasionally prove difficult.
2. It is more time-consuming for the radiologist.
3. There is a higher radiation dose to the patient (screening the tube into position).

Indications and Contraindications

These are the same as for a barium follow-through

Contrast medium

1. E-Z Paque 70% w/v diluted
2. Dilute Baritop
3. 600ml of 0.5% methylcellulose after 500 ml of 70% w/v barium.

Equipment

A choice of tubes is available:

1. Bilbao-Dotter tube with a guidewire
2. Silk tube. This is a 10-F, 140-cm long tube.It is made of polyurethane and the stylet

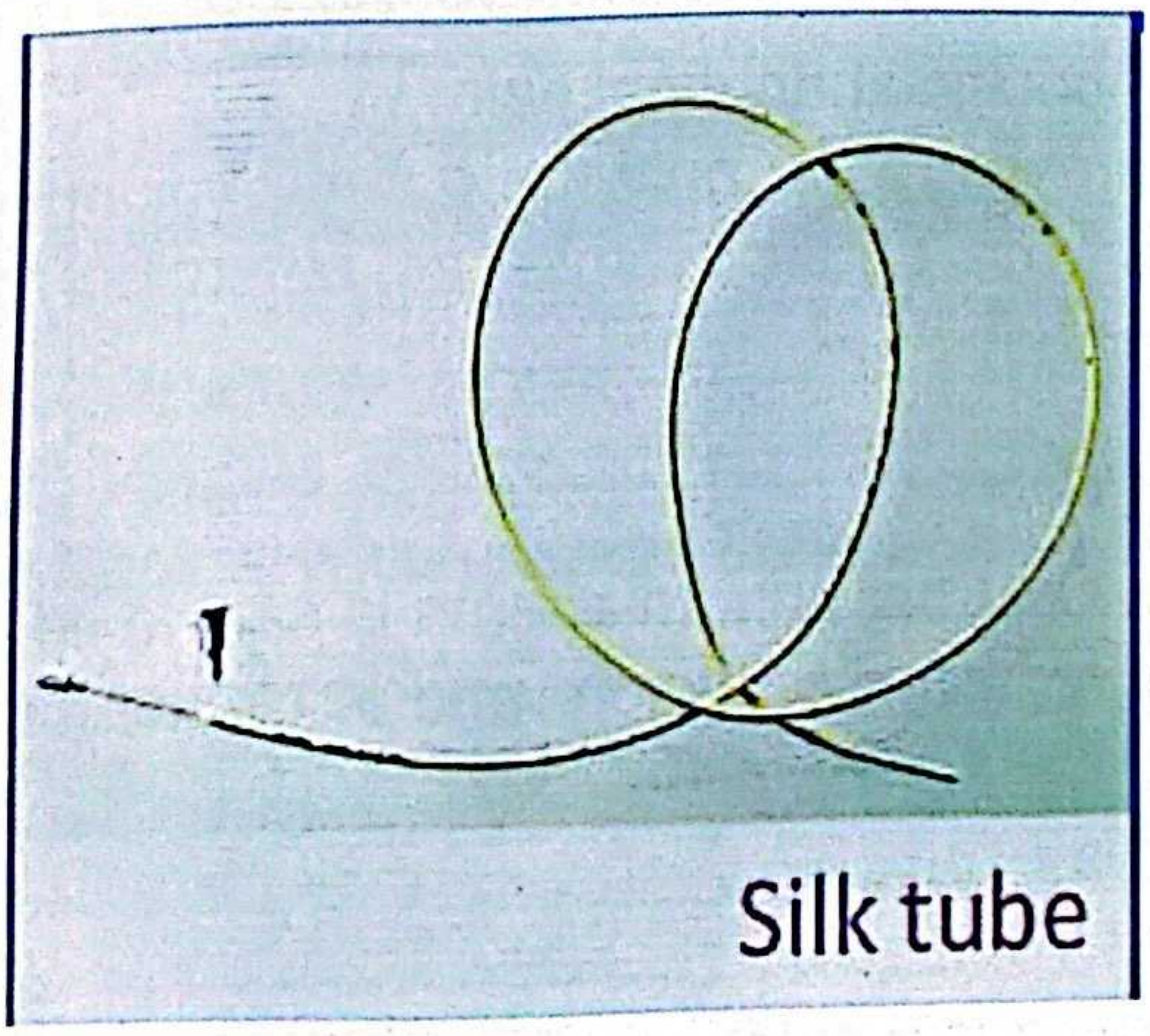
Patient preparation

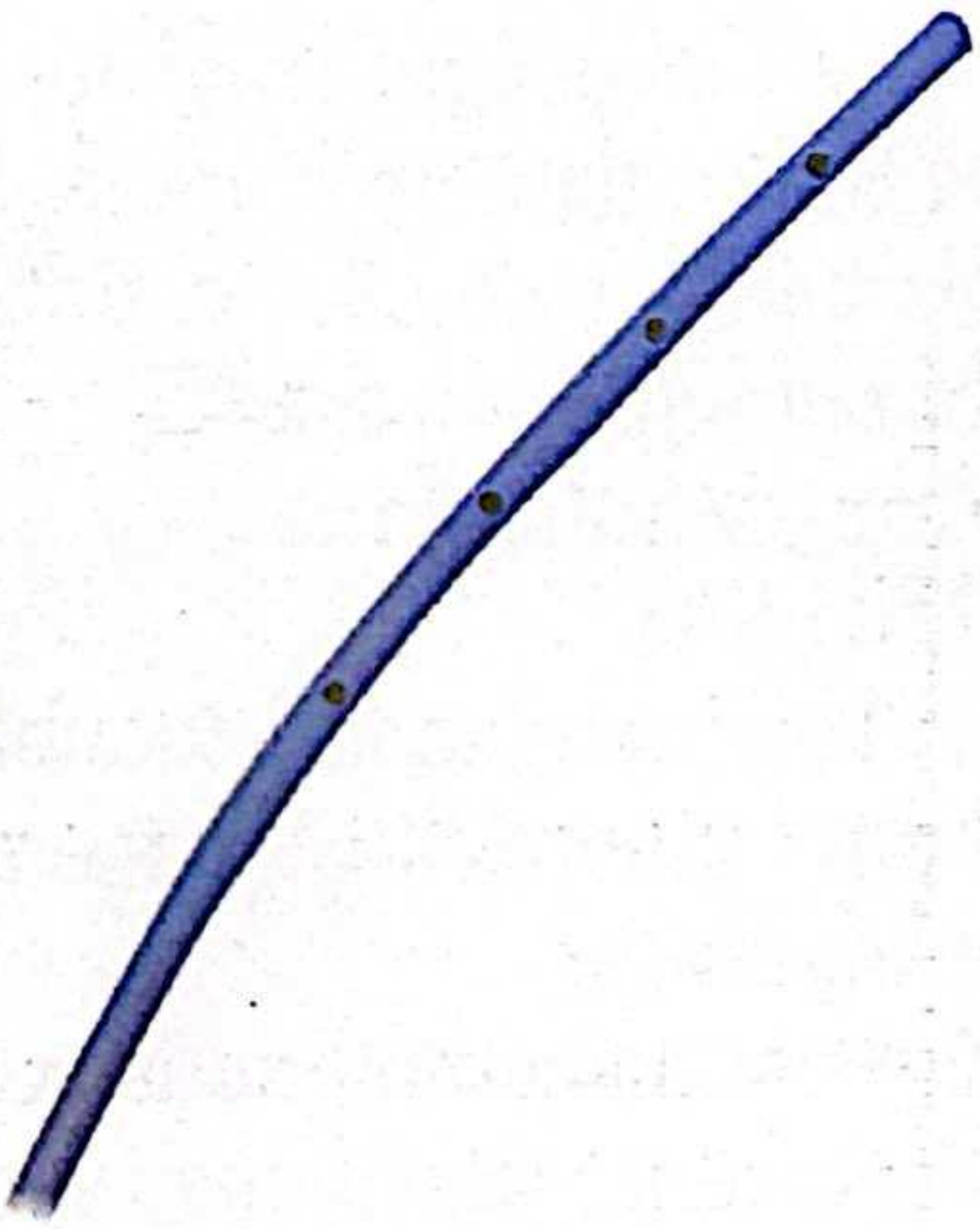
1. NBM after midnight
2. If the patient is taking any antispasmodic drugs, they must be stopped 1 day prior to the examination
3. Tetracaine lozenge 30 mg, 30 min before the examination.

Immediately before the examination the pharynx is anaesthetized with lidocaine spray.

Preliminary film

Plain abdominal film is used if a small bowel obstruction is suspected.





BARIUM ENEMA

Methods

1.Double contrast – the method of choice to demonstrate mucosal pattern.

The 'double contrast' refers to the use of positive and negative contrast agents to increase the sensitivity of the examination.

The double contrast study is sensitive to visualize mucosal irregularities.

- Positive contrast: barium or barium-like agent, e.g. Gastrograffin ®
- Negative contrast: air or CO2

2. Single contrast – uses:

a. children – since it is usually not necessary to demonstrate mucosal pattern

b. reduction of an intussusception

c. localization of an obstructing colonic lesion.

Indication

- Suspected large bowel pathology.
- Detection of polyps and colorectal cancer
- Follow up screening for postoperative colorectal cancer
- Evaluation of diverticular disease
- Failed colonoscopy
- Investigation of non-specific abdominal pain

N.B. If a tight stricture is demonstrated, only run a small volume of barium proximally to define the upper margin, as otherwise the barium may impact.

Contraindications

Absolute

1. Toxic megacolon (double-contrast barium enema is said to be no better than clinical judgement in this situation, and is clearly more dangerous)
2. Pseudomembranous colitis
3. Recent rectal biopsy via:

a. rigid endoscope within previous 5 days

b. flexible endoscope within previous 24 h.

Relative

1. Incomplete bowel preparation
2. Recent barium meal – it is advised to wait for 7–10 days
3. Patient frailty.

Contrast medium

1. Polibar 115% w/v 500ml (or more, as required)

2. Air.

Equipment

Miller disposable enema tube.

Patient preparation

Many regimes for bowel preparation exist. A suggested regime is as follows:

For 3 days prior to examination

Low residue diet.

On the day prior to examination

1. Fluids only
2. Picolax – at 08.00 h and 18:00 h.

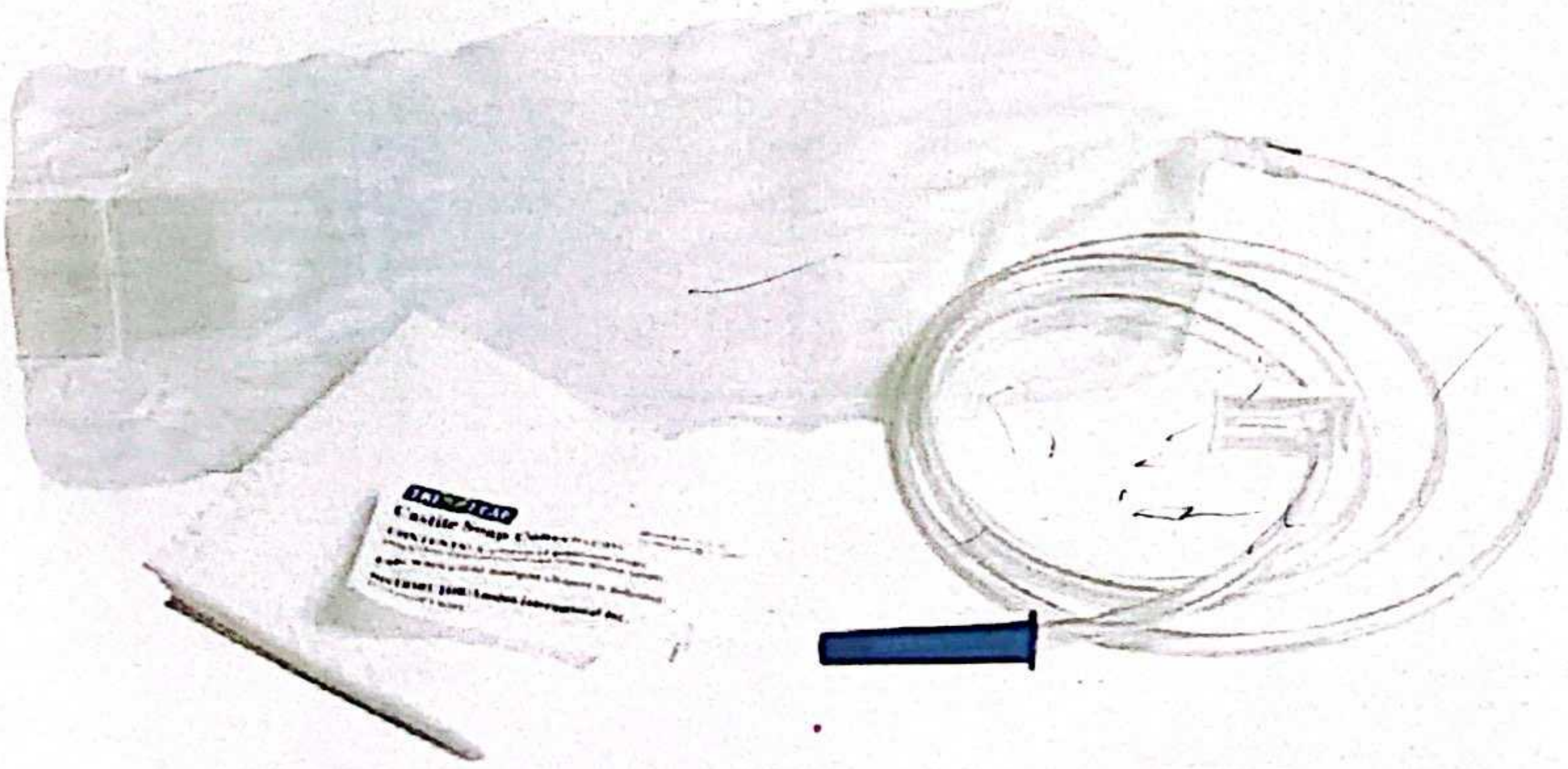
Consider admitting the elderly and those with social problems.

On the day of the examination

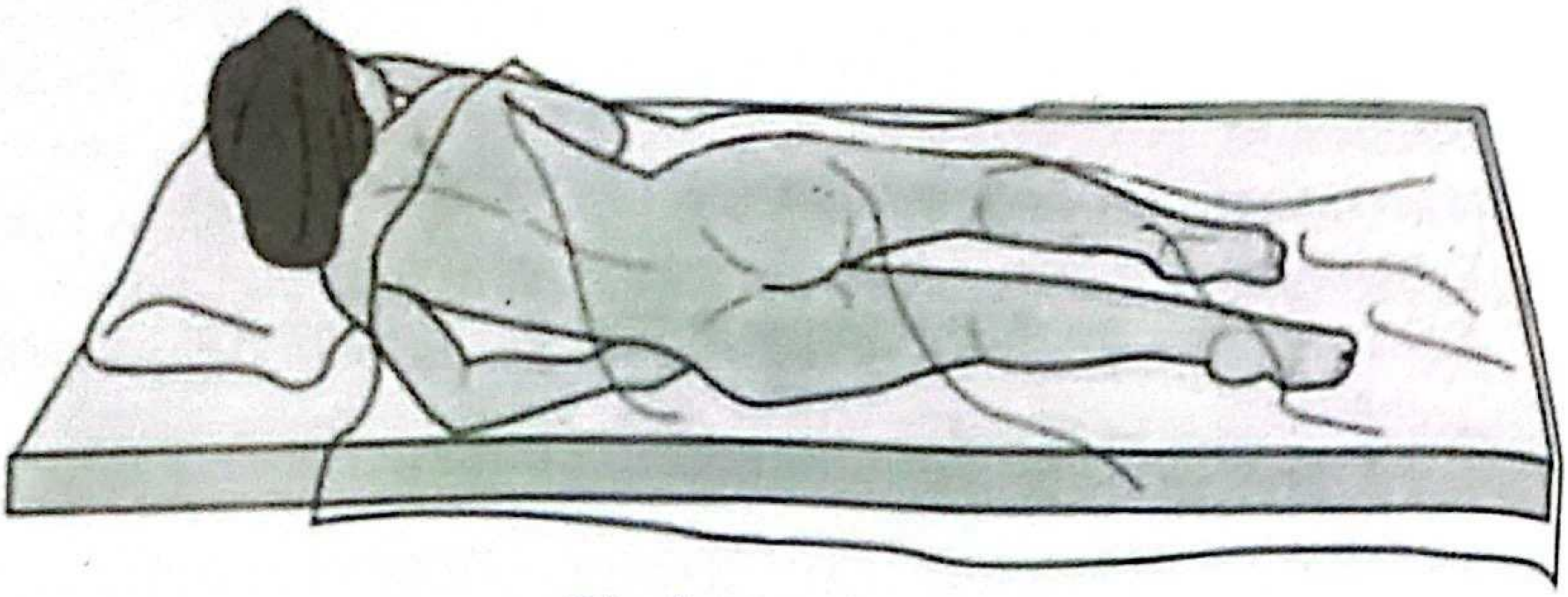
It is advisable to place diabetics first on the list.

Complications (all are rare)

1. Perforation of the bowel. There is an increased risk of this in:
    a. Infants and the elderly
    b. Obstructing neoplasm
    c. Ulceration of the bowel wall
    d. Inflation of a Foley catheter balloon in a colostomy, or the rectum
    e. Patients on steroid therapy
    f. Hypothyroidism.
2. Transient bacteraemia
3. Side-effects of the pharmacological agents used
4. Cardiac arrhythmia due to rectal distension
5. Intramural barium
6. Venous intravasation. This may result in a barium pulmonary embolus, which carries 80% mortality.



Miller Barium Enema Tube



Sim's position.

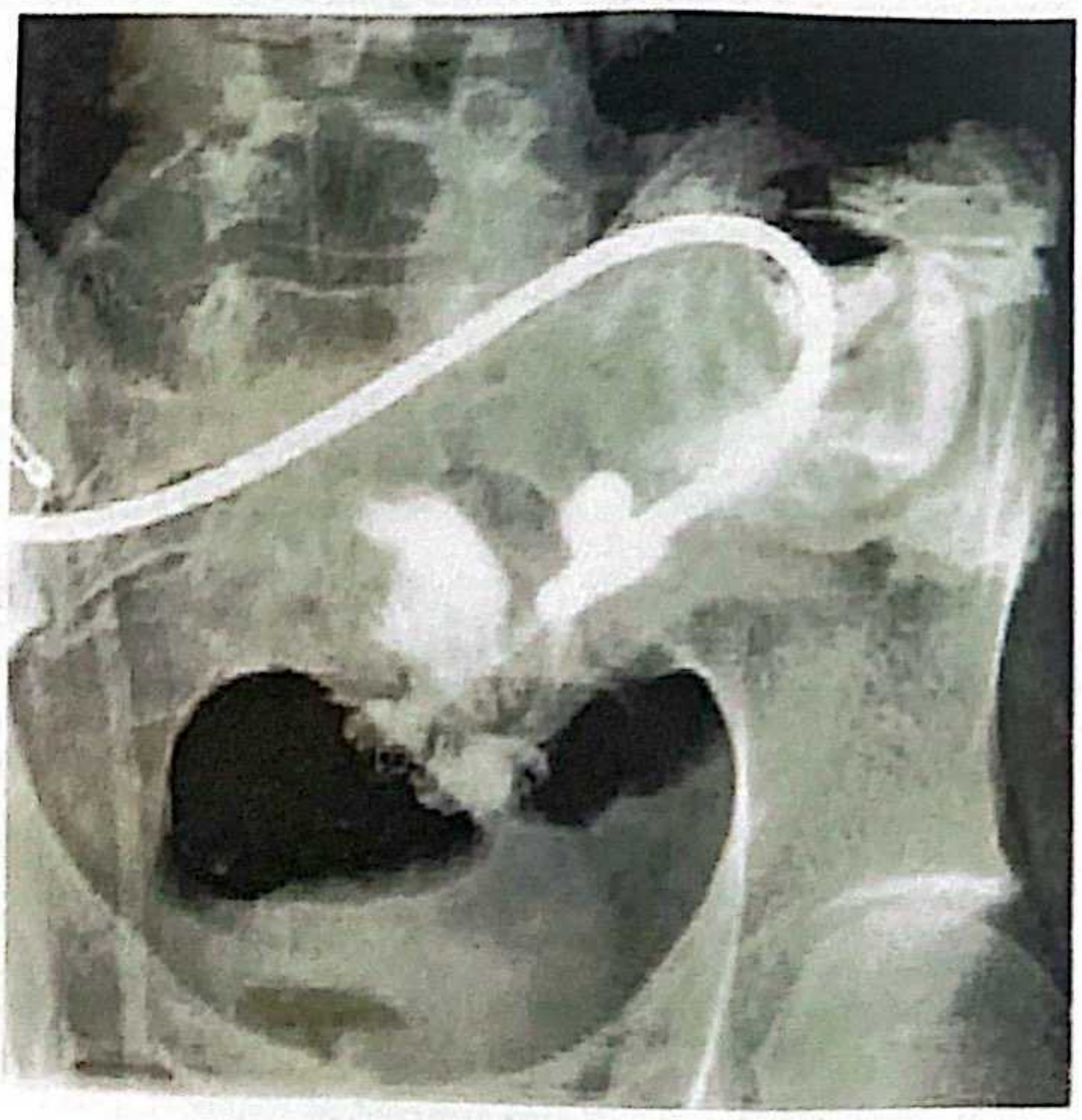
AIR ENEMA

Indications

Demonstrate extent of ulcerative colitis.

Technique

1. Insert 14–16-F Foley catheter into rectum and inflate balloon (10–20 ml)
2. Take preliminary overcouch anterior posterior (AP) film of abdomen
3. View film and without the patient moving give relaxant, e.g. Buscopan and then inflate air (gentle puffs) into catheter lumen
4. Take AP film of abdomen.



FISTULOGRAMS AND SINOGRAMS

INDICATIONS

May be used in postoperative patients for assessment of fistulae and sinus tracts

Contrast injected into a catheter placed into the fistula tract demonstrates communication with

the small intestine in this patient with Crohn's disease

Endoscopy

INDICATIONS

Upper and lower GI endoscopy enable direct visualization and directed biopsies.

Endoscopic retrograde cholangiopancreaticography (ERCP) visualizes the hepatobiliary tree.

LOOPOGRAM

Indications

Appropriate in patients following bladder resection to demonstrate anatomy of ileal conduit, ureters, and renal pelvicalyceal systems.

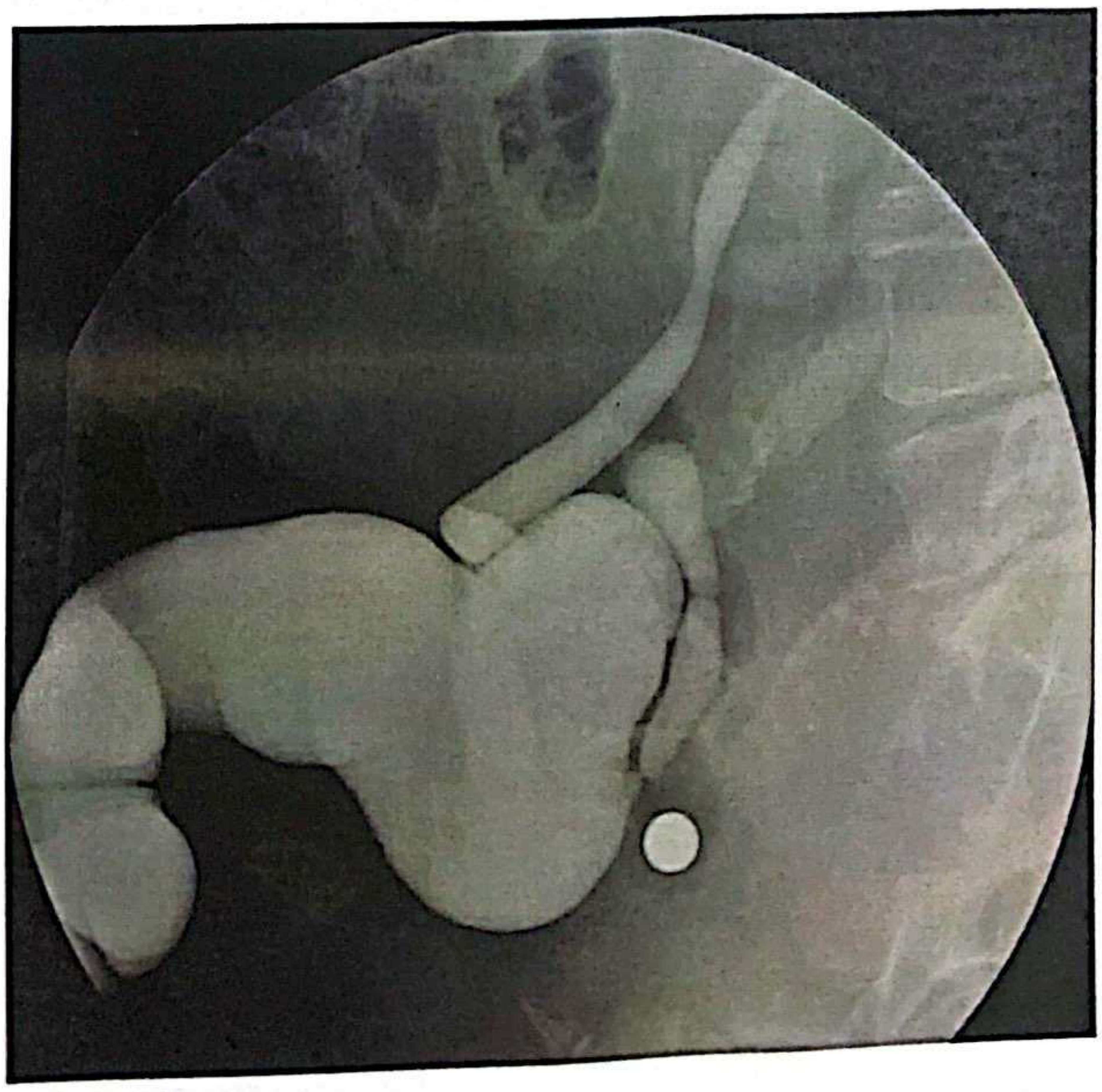
This procedure is also known is an ileal conduitogram, ileal loopography or ileostoureterography

Contrast

Low concentration water-soluble contrast agent (150 mg/ml).

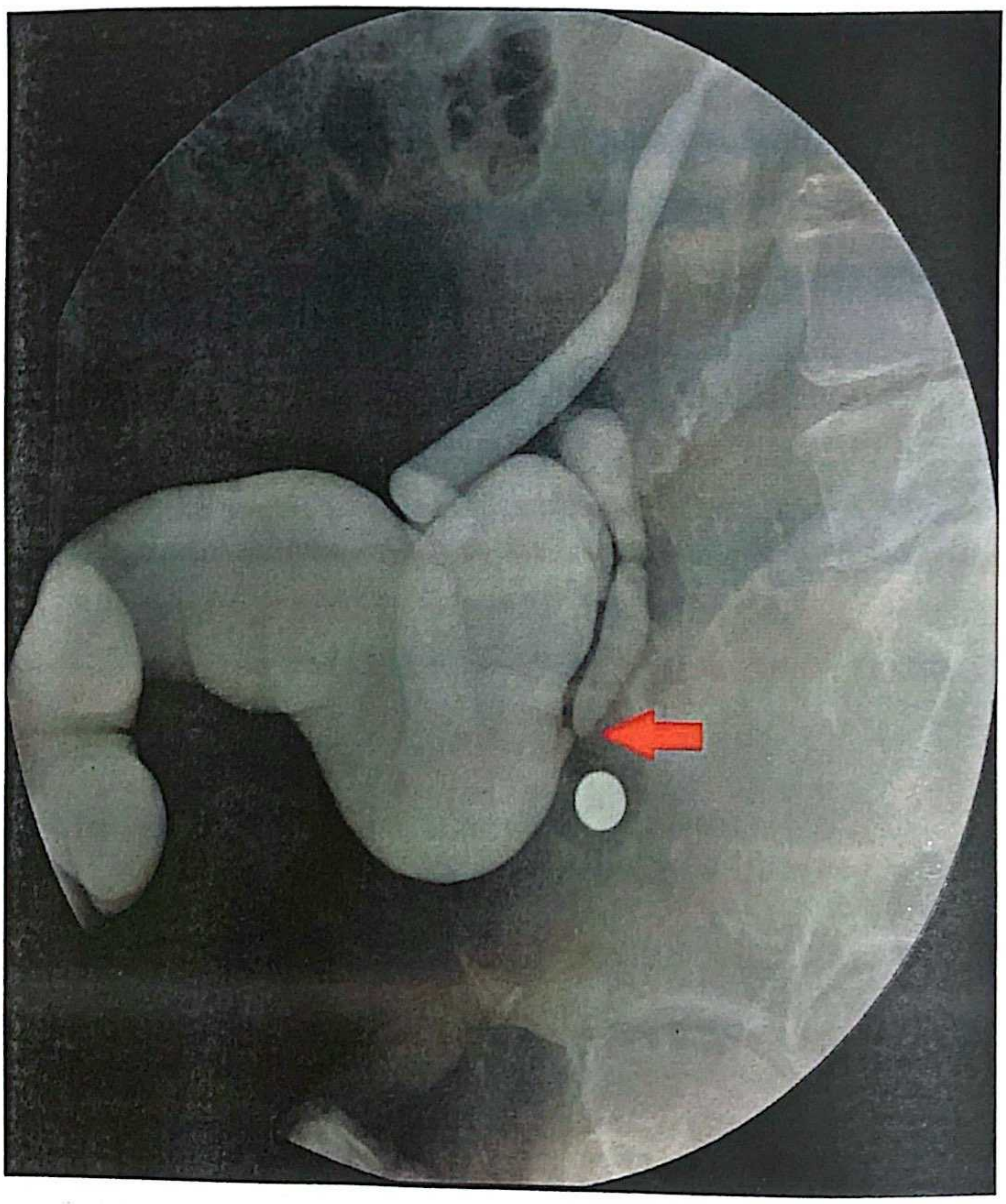
Technique

Cannulate ileal conduit with 14–18-F Foley catheter and gently inflate balloon. Inject contrast into ileal conduit.

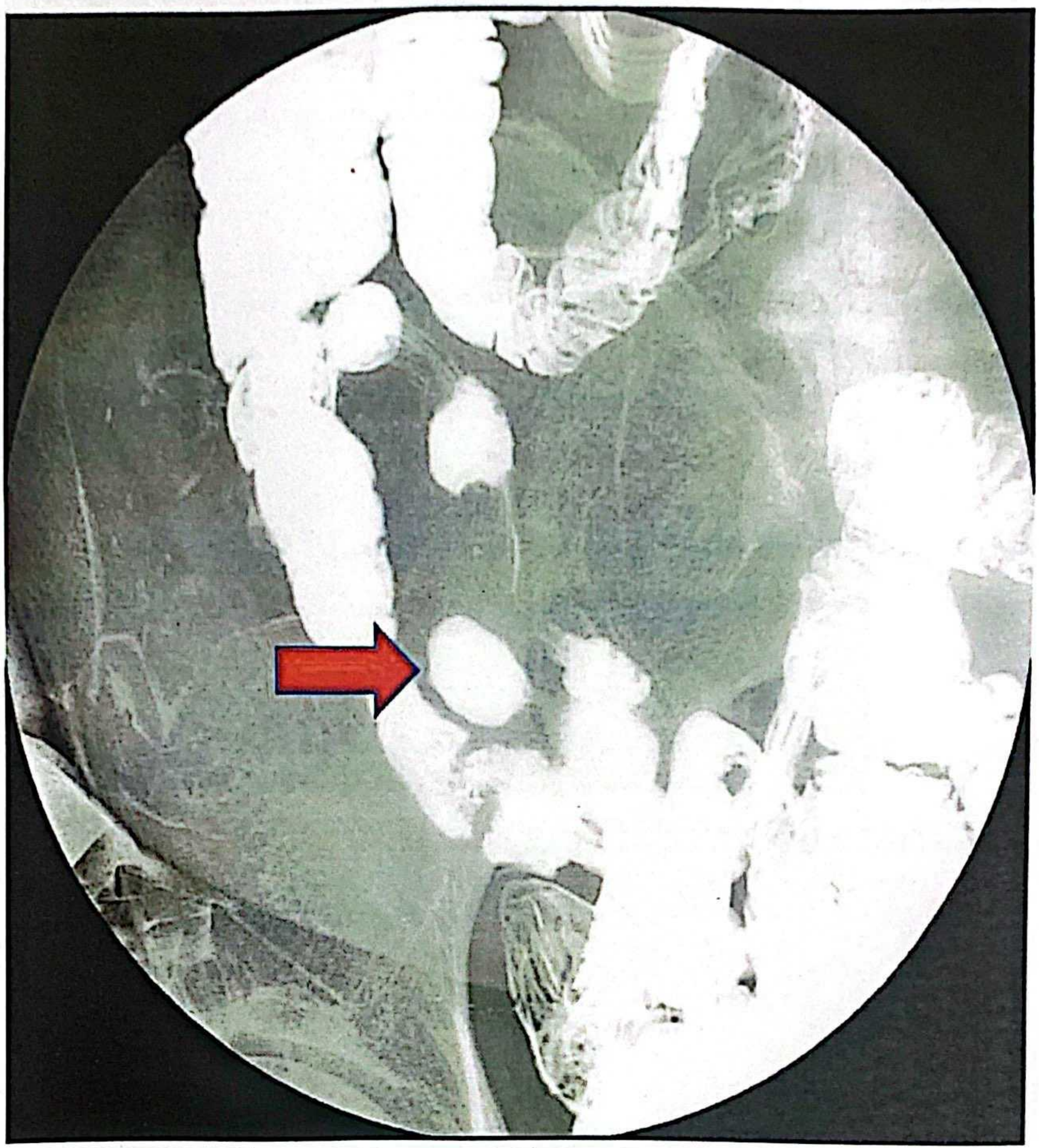


Identify: Ileal conduit (loopogram)
Describe: a short segment narrowing/stricture at the ureteral anastomosis is evident.
Diagnosis: Ureteroileal anastomotic stricture (ileal conduit)
What next: CT urography

The arrow points to the tight distal ureteroileal stenosis



Q.16) Nonspecific epigastric pain. History of prior abdominal surgery.AGE: 50-60Y-Male

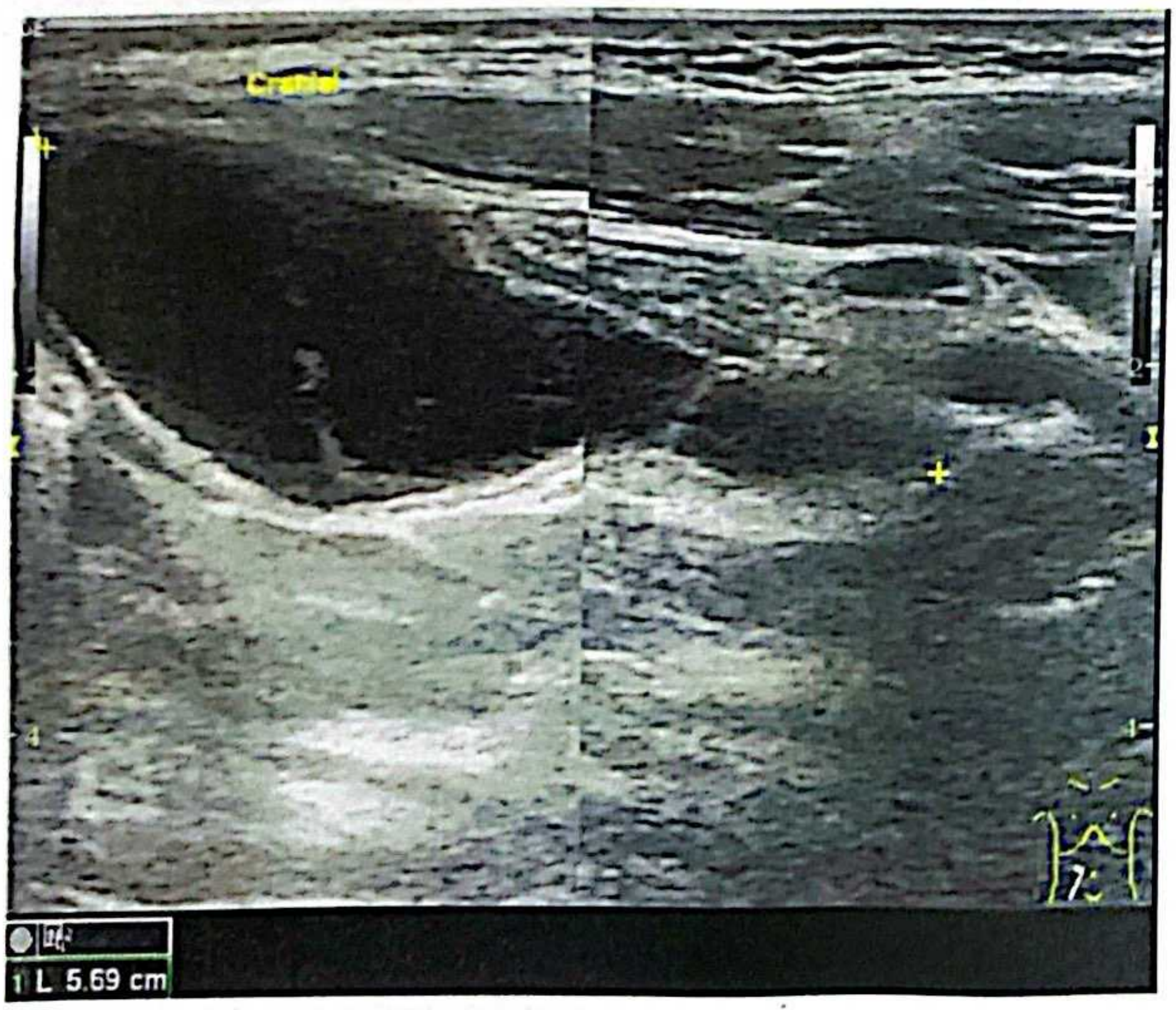


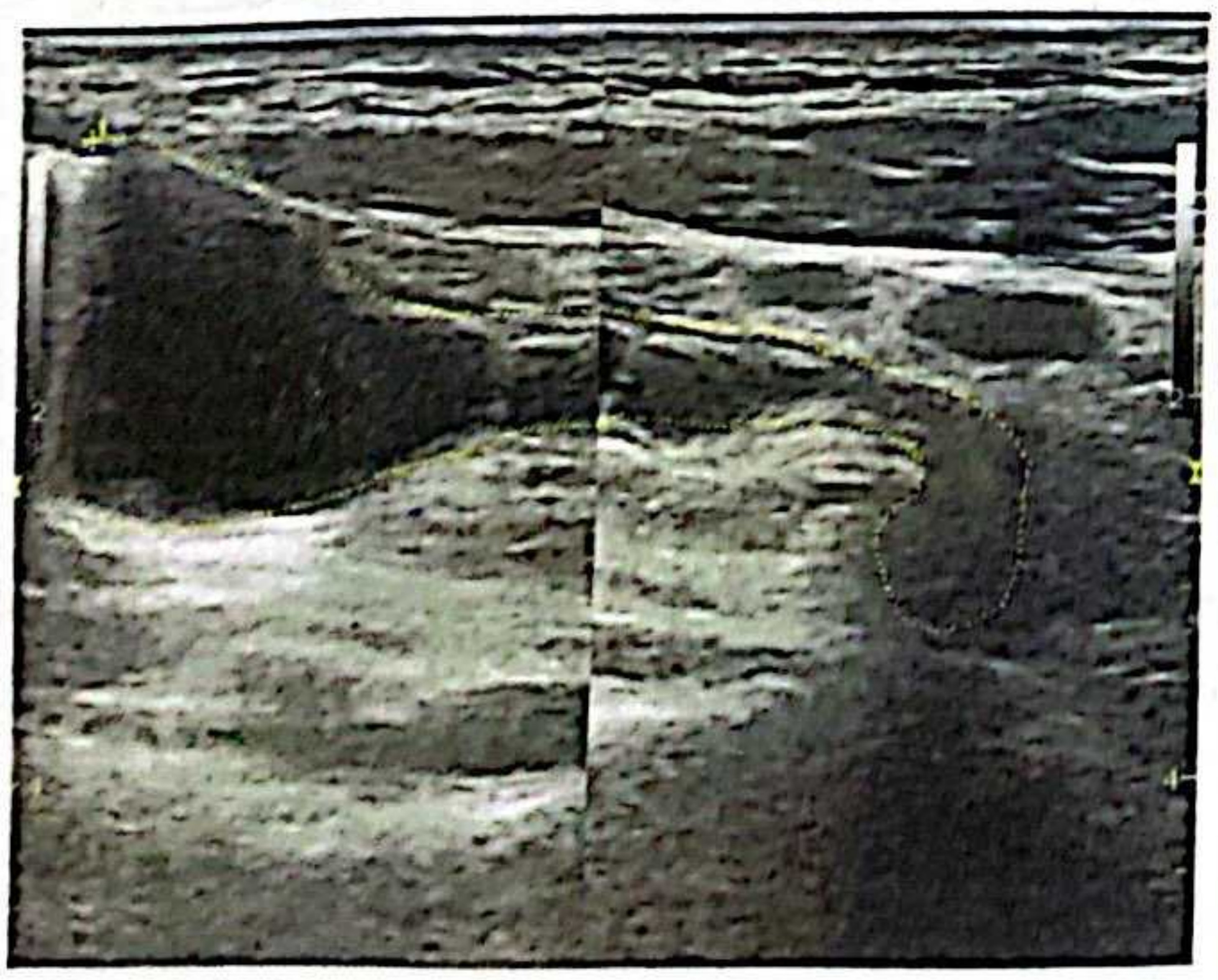
There is 2 cm diverticular outpouching a little less than 2 feet from the terminal ileum, compatible with a Meckel diverticulum. The terminal ileum has a normal single contrast appearance. The small bowel was otherwise normal.

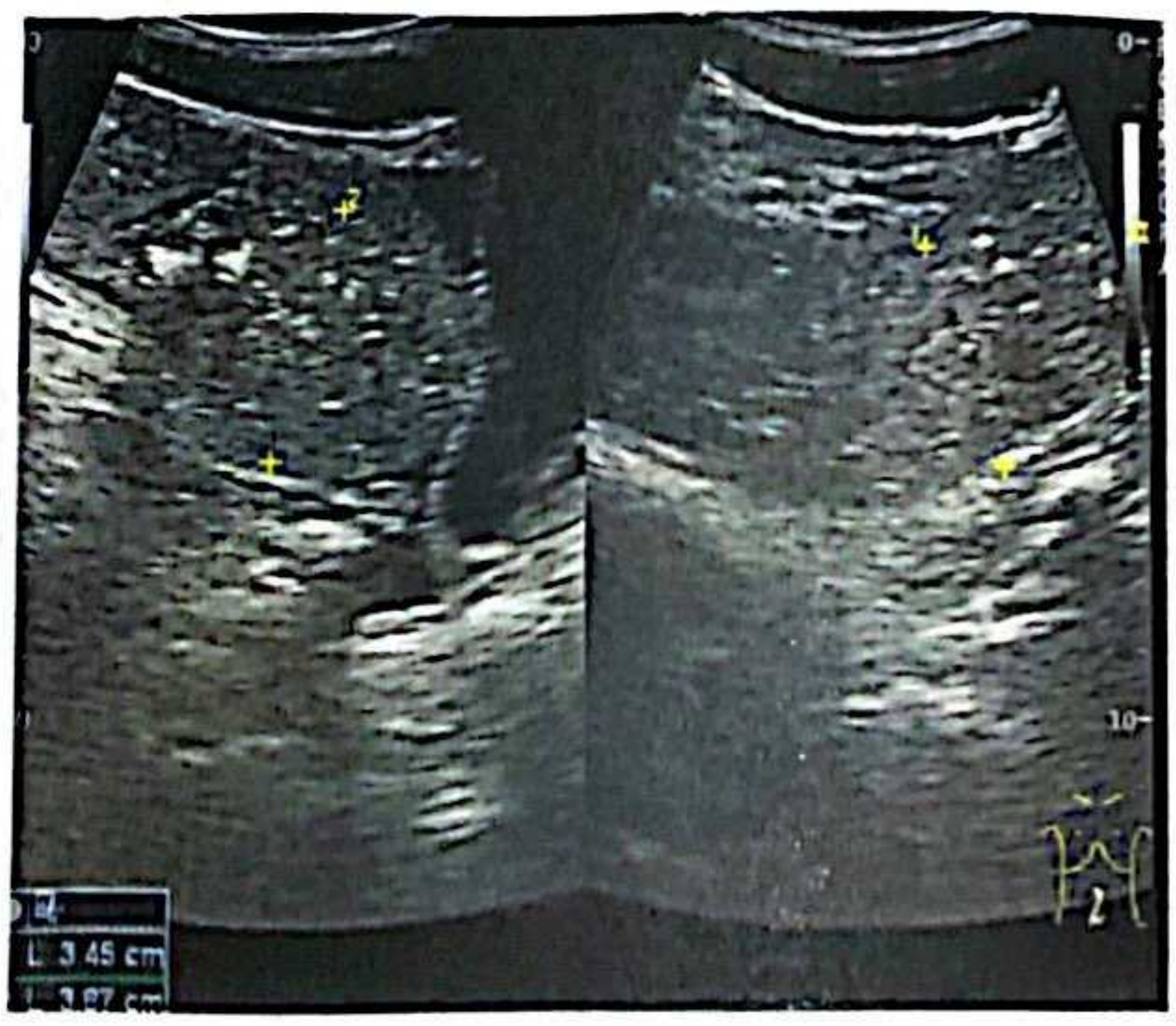
Can get diverticulitis in the Meckel's (mimic appendix)
GI Bleed from Gastric Mucosa (causes 30% of symptomatic cases)
Can be a lead point for intussusception
(seen with inverted diverticulum)
- Can cause Obstruction

There are dilated small bowel loop in lower abdomen with maximum diameter upto 35 mm. Transition is seen in right iliac fossa / right para-umbilical region. There is no bowel wall odema.

There is a tubular, aperistaltic structure in right umbilical region / right iliac fossa. Blind end is near umbilicus. The other end is direct to right iliac fossa. There is fluid with air in this structure. It appears to join small bowel.

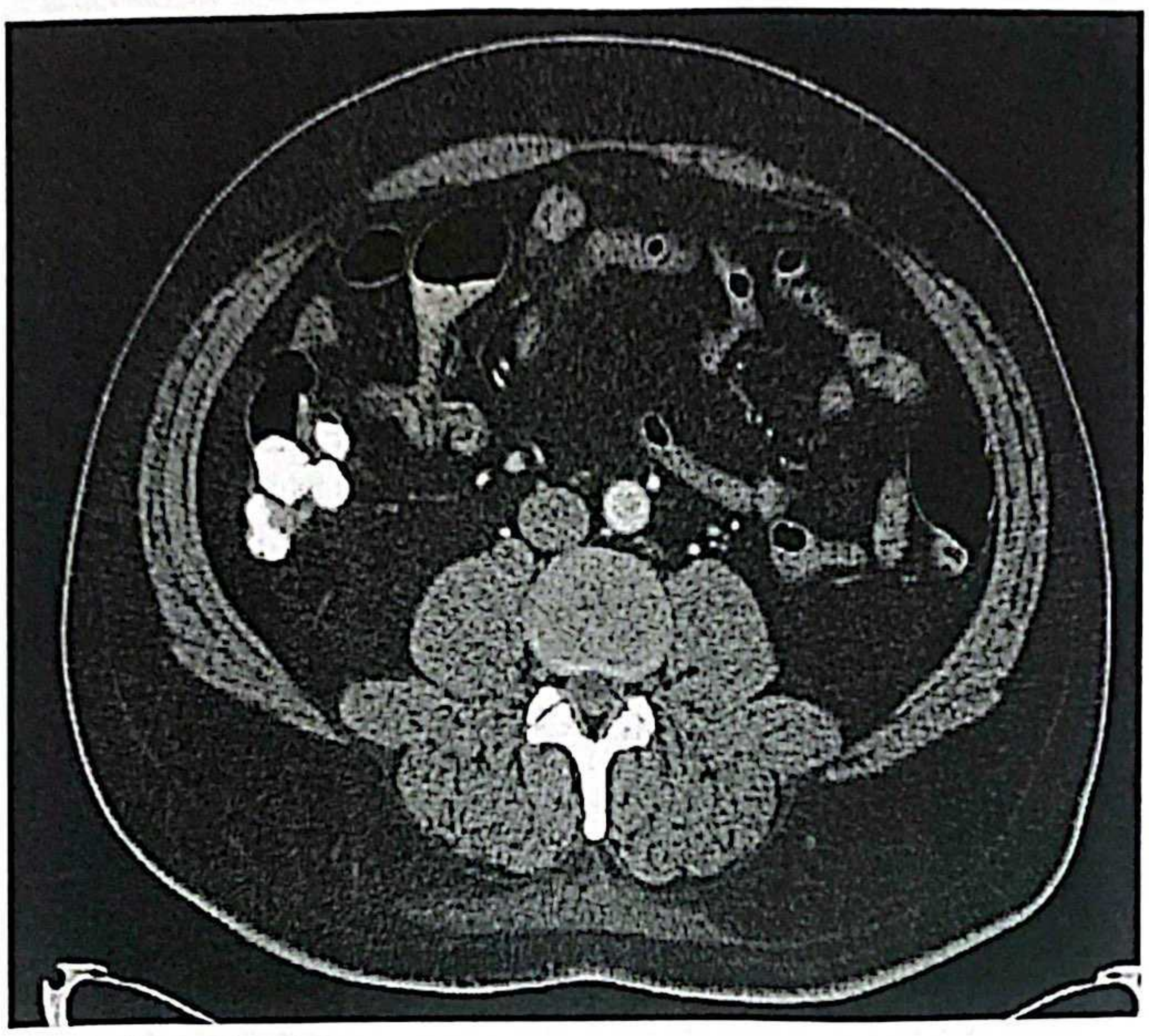




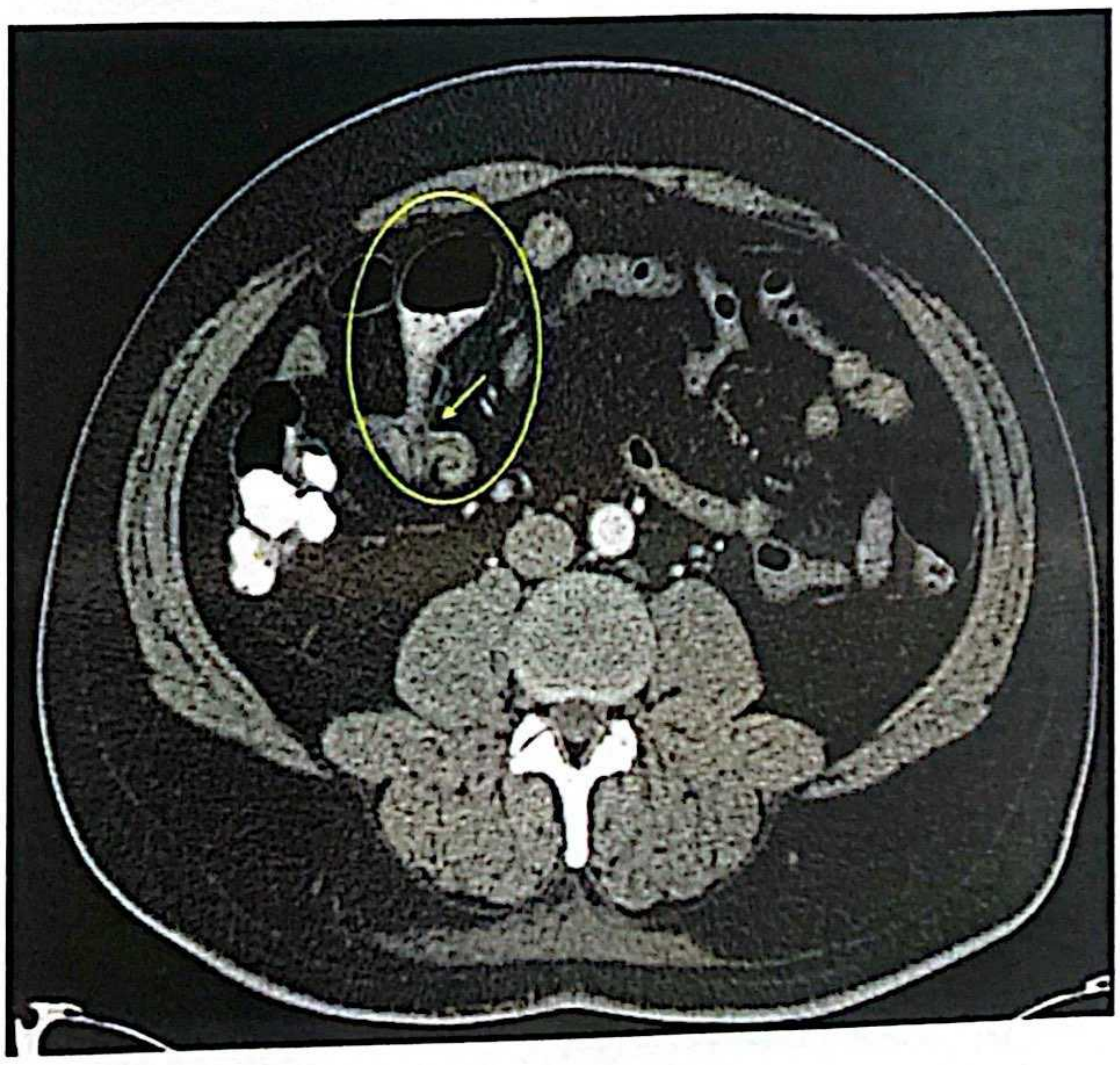


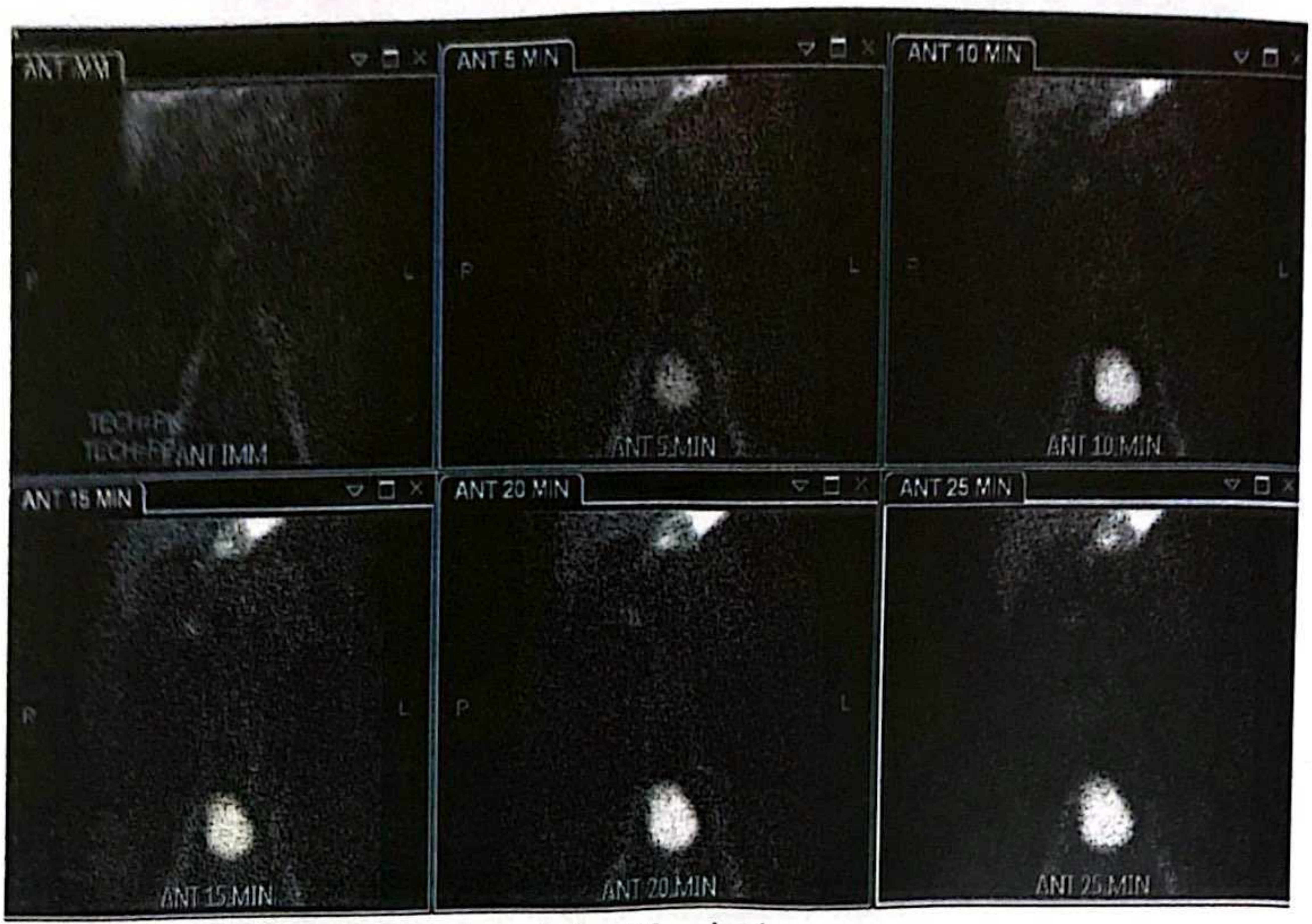
In the right mid abdomen there is a blind ending, air-filled, distended tubular/ diverticular structure originating off the distal ileal bowel, measuring approximately 6.5cm in length. The base of the diverticulum is narrowed at its origin. There is no signs of inflammation about the diverticula.

of inflammation about the diverticula.



There is a blind ending, air-filled, distended tubular/diverticular structure originating off the distal ileal bowel (yellow oval), with the base of the diverticulum being narrowed at its origin (yellow arrow). Findings are consistent with Meckel diverticulum.

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TECH=PK
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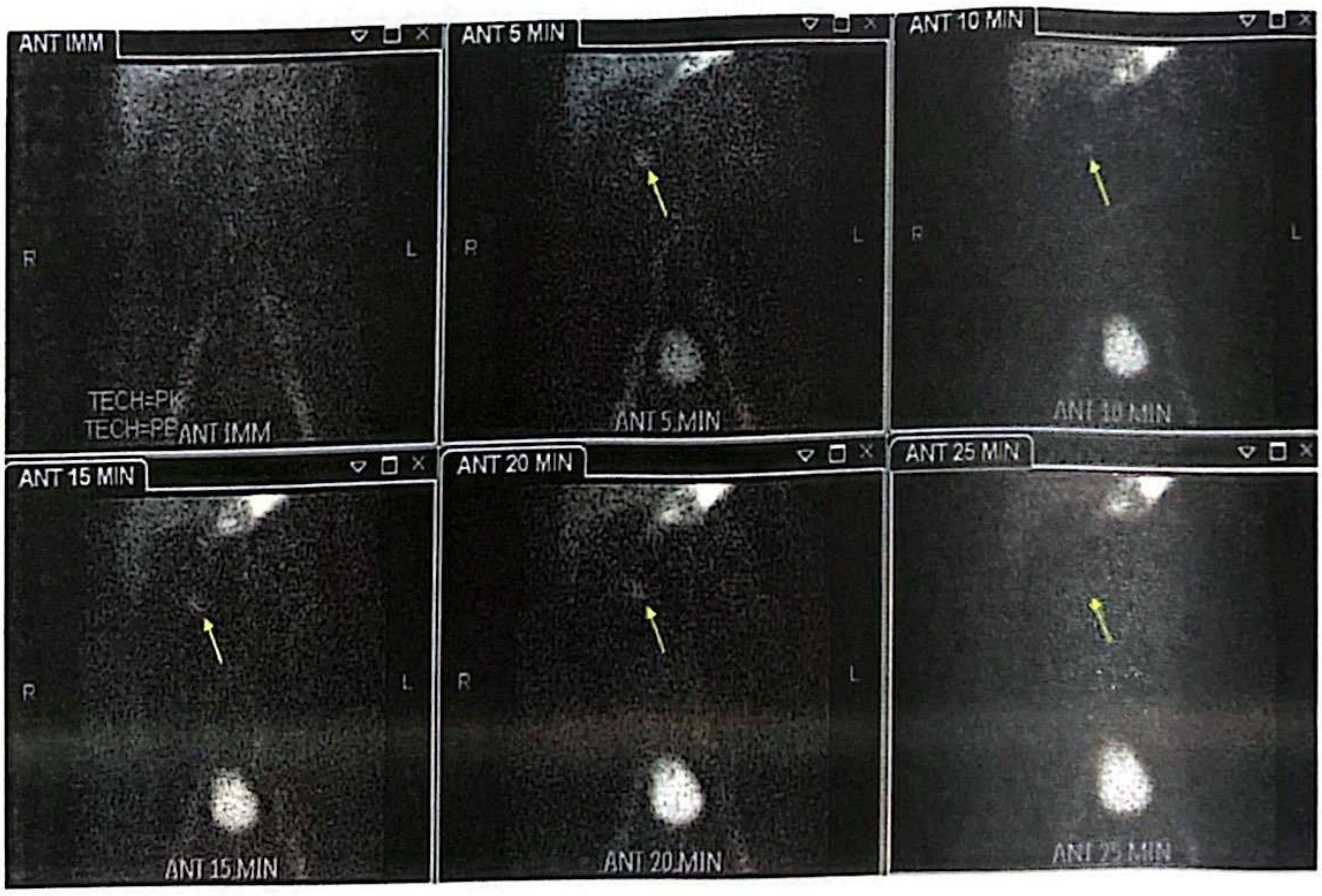
Technetium 99m pertechnetate Meckel scan.
The scan shows faint focal uptake in the right upper-mid abdomen on the 5, 10, 15, 20 and 25-minute delayed images (yellow arrows), consistent for Meckel diverticulum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Fluoroscopy
Small bowel enemas have sometimes been used for the diagnosis in some centres, although a precise technique is required if the diagnosis is to be excluded with any degree of certainty.

Ultrasound

Usually of limited in the diagnosis of an uncomplicated Meckel diverticulum. Ultrasound may show a blind-ending peristaltic loop connected to the small bowel.

CT

CT is of limited value in uncomplicated cases, as the diverticulum may resemble a normal bowel loop. CT may show a fluid- or air-filled blind-ending pouch that arises from the antimesenteric side of the distal ileum.

It is possible for the diverticulum to invert and appear as an intraluminal polypoid lesion.

Angiography or CT angiography

When investigated in the context of gastrointestinal haemorrhage, angiography/CT angiography may show the persistent omphalomesenteric artery in most individuals with a Meckel diverticulum although recognition of the artery may be difficult due to overlying vessels.

Scintigraphy

Scintigraphy with 99mTc-Na-pertechnetate has a limited sensitivity (~60%) 2,9; however, it aids in the diagnosis of diverticula with ectopic gastric mucosa. Pertechnetate is taken up by mucin-secreting cells of the gastric mucosa and ectopic gastric tissue. Higher sensitivity may be present in children (85-90%).

Blood supply

arterial supply typically arises from the omphalomesenteric artery (arising from an ileal branch of the superior mesenteric artery)

Plain Abdominal Film

Often the first preliminary test

INDICATIONS

- Bowel obstruction
- Viscus perforation
- Foreign body ingestion

ADVANTAGES

- Easy availability
- Low cost

LIMITATIONS

- Screening modality; usually need another imaging test to confirm diagnosis
- Lack of anatomic detail

Abdominal Ultrasound

APPROACHES

- Superficial
- Endoscopic: Assisting probes are used in upper GI, pancreaticobiliary, and colorectal pathologies for staging malignancies

INDICATIONS

- Gallbladder and hepatic pathology
- Delineation and differentiation of intra-abdominal cystic structures
- Trauma; FAST (focused abdominal sonography in trauma) is a very useful tool in assessment of trauma patients
- Emerging role of endoscopic ultrasound in biliary and pancreatic pathologies
- Guiding procedures
- Doppler studies for evaluation of vascular structures

ADVANTAGES

Inexpensive, noninvasive, no contrast

LIMITATIONS

- Operator dependent
- Inferior for assessment of bowel pathology due to artifact from air
- Lack of mucosal detail

Abdominal CT

INDICATIONS

- Assessment of acute abdomen and to rule out conditions such as acute appendicitis, acute pancreatitis, small bowel obstruction, colitis.
- Trauma
- CT angiograms for suspected vascular leaks, aneurysm, bowel infarctions
- CT enterography is being used for inflammatory bowel diseases (Crohn's disease).
- Virtual CT colonoscopy: Not yet a very widely used tool

ADVANTAGES

Excellent cross-sectional imaging modality that provides functional information as well

LIMITATIONS

- Availability
- Radiation exposure
- Expensive

MRI

Esophagitis	Fold Thickening. May have smooth stricture at GE junction if severe
Barretts	Reticulated Mucosal Pattern Classically shown as Hiatal Hernia + High Stricture
Medication Induced Esophagitis	Ulcers; Usually at the level of the arch or distal esophagus
Crohns Esophagitis	Ulcers can be confluent in severe disease
Candida	Discrete plaque like lesions that are linear or irregular filling defects that tend to be longitudinally oriented, separated by normal mucosa Buzzword: Shaggy -when severe Not always from AIDS, can also be from motility disorders such as achalasia and scleroderma
Herpes Ulcers	Multiple small, with Edema Halo (herpes has halo)
CMV / AIDS	Large Flat ulcers
Achalasia	Bird Beak,- smooth stricture at GEjunction Path is failure of LES to relax (but it will slowly relax) Increased risk of Squamous Cell CA, and Candida
Pseudo achalasia	Cancer at the GE junction. Fixed Obstruction, will not relax
Scleroderma	Involves the Esophagus 80% of the time Looks a little like Achalasia (they will show you lung changes) Sequelae of reflux: stricture, barrets, cancer
Long Stricture	DDx: NG tube in too long, Radiation, Caustic Ingestion
Pseudo diverticulosis	Dilated submucosal glands, usually due to chronic reflux esophagitis. Esophageal stricture is seen in 90% of cases
Zenker Diverticula	Zenker in the back (above cricopharyngeus)
Killian-Jamieson	Lateral (below cricophruyngeus)

ADVANTAGES

- Superior soft tissue detail
- Excellent cross-sectional imaging tool for evaluation and staging of malignancies, especially rectal and esophageal, inflammatory and obstructive pathologies

DISADVANTAGES

- Higher cost
- Contraindicated in patients with metallic hardware
- Long imaging time
- Claustrophobia

High Yield Esophagus

High Yield Stomach

Location:

- H Pylori Gastritis- Usually in Antrum
- Zollinger-Ellison- Ulcerations in the stomach (jeujunal ulcer). Duodenal bulb is the most common location for ulcers in ZE.
- Crohns - Uncommon in the stomach, but when it is, it likes the antrum Menetrier's - Usually in the Fundus (classically spares the antrum)
- Lymphoma - "C.-osses the Pylor us" - classically described as doing so, although in reality adenocarcinoma does it more.

Benign Versus Malignant Ulcers Difference

Parameter	Benign Ulcer	Malignant Ulcer
Mucosal/ Radiating folds	Thin, regular, extend up to crater edge, symmetric	Thick, irregular, do not extend through collar, nodular, clubbed, fused
Penetration	Margin of ulcer crater extends beyond projected outside lumen surface	Ulcers project within (projected) luminal surface; Carman's, Kirklin (meniscus) sign*
Crater	Round	Ovoid irregular
Location	Centrally within mound of edema	Eccentrically in tumor mound
Areae gastricae	Preserved	Destroyed
Ulcer mound	Smooth	Rolled edge
Collar	Hampton's line: 1 to 2mm lucent line around the ulcer†	Thick, nodular, irregular
Peristalsis	Normal peristalsis, Incisura: invagination of opposite wall	Limited peristalsis, Limited distensibility
Gastrohepatic lymph nodes	Occasional	Common

Fold Pattern

Thin Folds with Dilation	Thick Folds> 3mm		Thick Folds with Nodularity	
Mechanical Obstruction	Segmental	Diffuse	Segmental	Diffuse
	Ischemia	Low Protein	Crohns	Whipples
Paralytic ileus	Radiation	Venous Infection	Lymphoid Congestion	Hyperplasia
Scleroderma	Hemorrhage	Cirrhosis	Lymphoma	Lymphoma
Sprue	Adjacent Inflammation		Mets	Mets
				Intestinal Lymphangiectasia

With regard to filling defects, the way to think about this is:

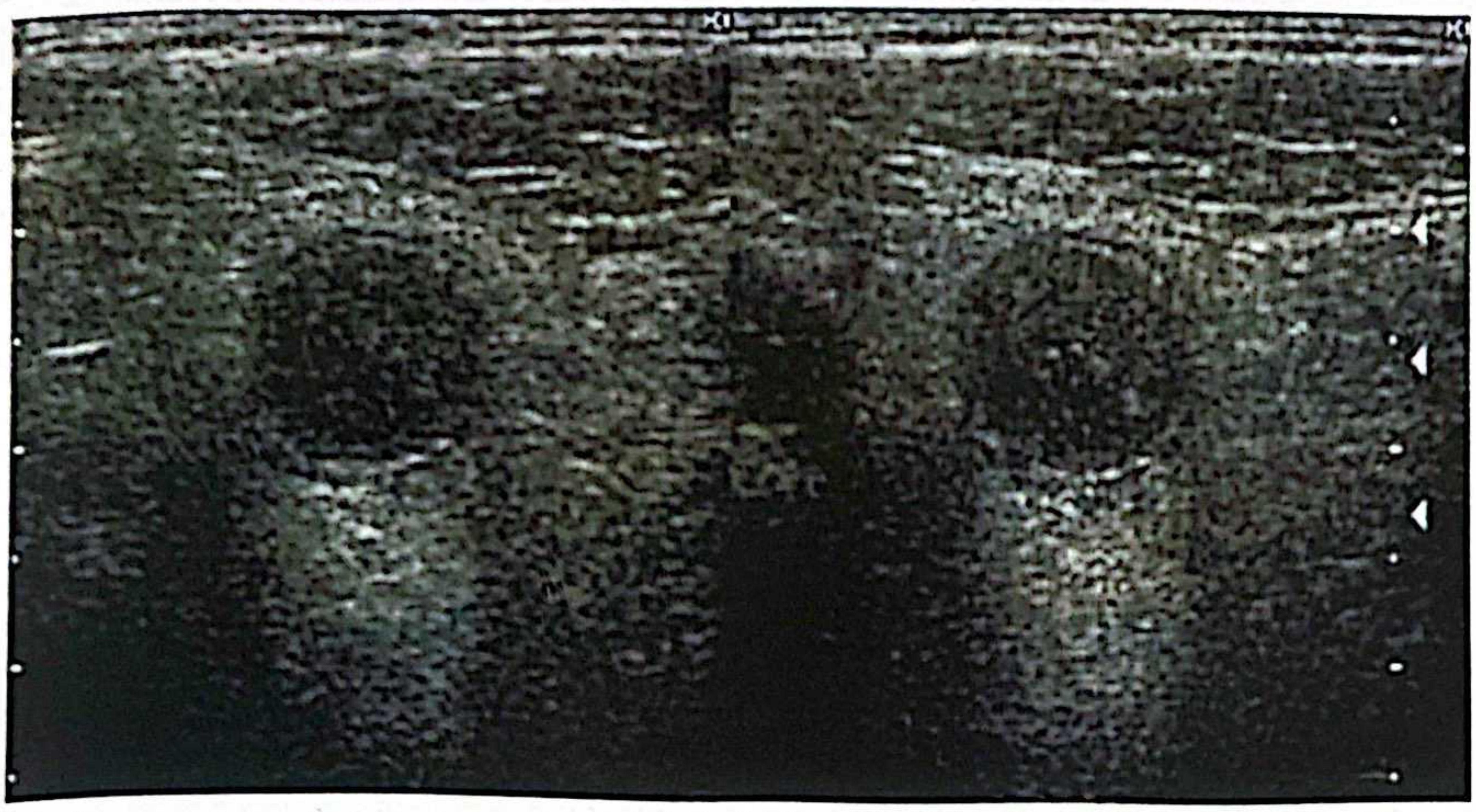
- Uniform 2-4mm nodules= Lymphoid Hyperplasia
- Nodules of larger or varying sizes = Cancer (probably mets and therefore probably melanoma).

Loop Separation can be thought about as with or without tethering

- Without Tethering= Ascites, Wall Thickening (Crolms, Lymphoma), Adenopathy, or Mesenteric Tumors
- With Tethering = Just say carcinoid
- A pearl is that extrinsic processes will spare the mucosa, intrinsic process with alter the mucosa

Barium Bowel Important Match's	
Fold Reversal	Celiac Sprue
Ribbon Bowel	Graft vs Host
Lead Pipe	Ulcerative Colitis
String Sign	Crohns
Hide Bound	Scleroderma
Coned Shaped	Amebiasis Cecum

Q.17) Right iliac fossa pain **(2015)**



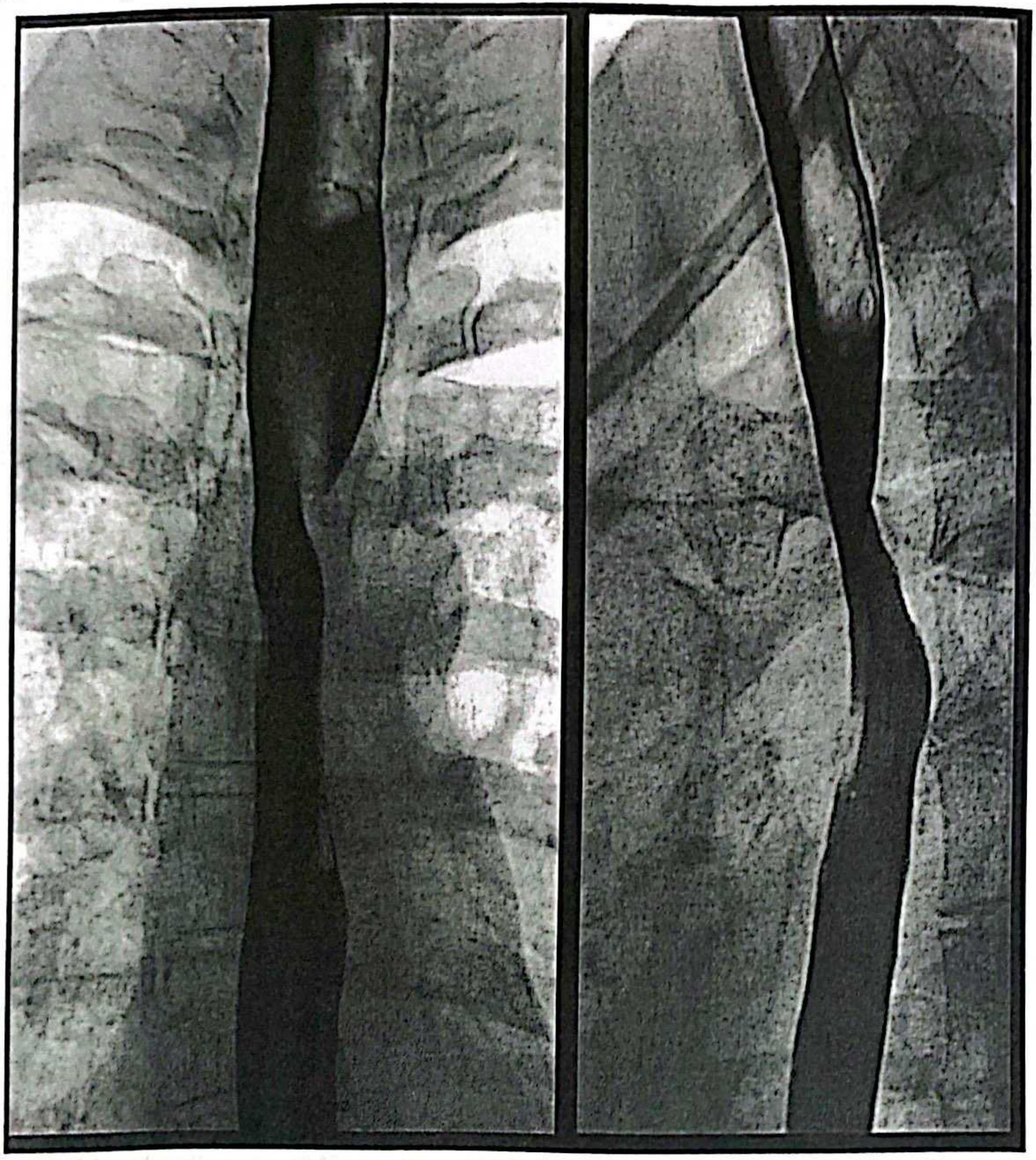
Findings supportive of the diagnosis of appendicitis include:

- aperistaltic, noncompressible, dilated appendix (>6 mm outer diameter)
- appendicolith
- distinct appendiceal wall layers
- echogenic prominent pericaecal and periappendiceal fat
- periappendiceal hyperechoic structure: amorphous hyperechoic structure (usually >10 mm) seen surrounding a noncompressible appendix with a diameter >6 mm 10
- periappendiceal fluid collection
- target appearance (axial section)
- periappendiceal reactive nodal prominence/enlargement

CT findings include:

- dilated appendix with distended lumen (>6 mm diameter)
- thickened and enhancing wall
- thickening of the caecal apex (up to 80%): caecal bar sign, arrowhead sign
- periappendiceal inflammation, including stranding of the adjacent fat and thickening of the lateroconal fascia or mesoappendix
- extraluminal fluid
- inflammatory phlegmon
- abscess formation
- appendicolith may also be identified
- periappendiceal reactive nodal prominence/enlargement

Q.18) Identify:



Identify: Radiograph Barium Swallow AP and Oblique views

Describe: Barium swallow reveals fixed narrowing because of indentation of the oesophagus at the level of the aortic arch without mucosal abnormality. The narrowing runs oblique from inferior left to superior right and involves the posterior aspect of the oesophagus. Contrast filled esophagus is displaced with bayonet deformity

Diagnosis: This is consistent with extrinsic compression by a retro-oesophageal aberrant right subclavian artery resulting in dysphagia lusoria.

What next: Contrast enhanced CT scan

CT or MRI now usually accomplishes the definitive diagnosis. Both modalities can demonstrate the aberrant branch arising from the distal left aortic arch and coursing as the right subclavian artery.

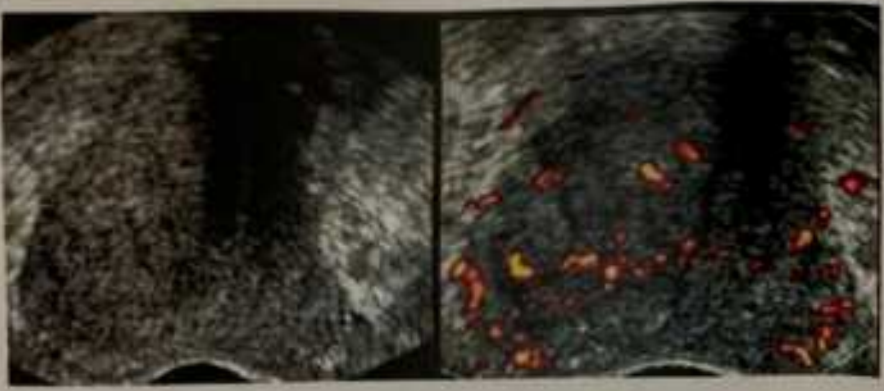
Associations:

1. Diverticulum of Kommerell
2. Trisomy 21
3. Trisomy 18

UROGENITAL SYSTEM

Q.1) Dysurea Abnormal PSA level, Nodular prostate on PR examination

(2017)



Identify: Transrectal Ultrasound (TRUS) Prostate with Grey Scale and Color Doppler Images

Describe: Hypoechoic lesion in the peripheral zone of the prostate gland with increased vascularity flow on color doppler

Diagnosis: Prostatic carcinoma

What next:

- Contrast enhanced MRI
- MR spectroscopy
- Tc99 MDP bone scan-usually used to detect metastases
- Ga68-PSMA scan-can be used for diagnosis, staging, restaging, evaluation of therapy response and prognostication in prostate cancer

Treatment: Prostatectomy, brachytherapy, or external beam radiation

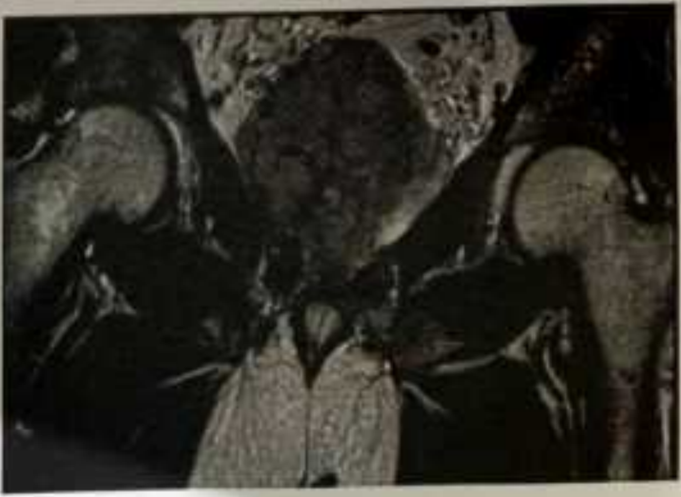
Extracapsular extension carries a poor prognosis

Differential Diagnosis:

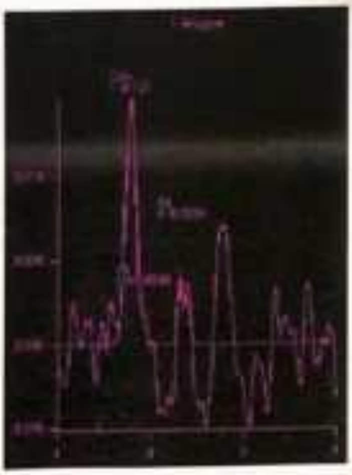
- Benign prostatic hypertrophy (BPH)
- Prostatic sarcoma
- Rhabdomyosarcoma of prostate
- Leiomyosarcoma of prostate
- Melanoma of prostate
- Invasion of the prostate by bladder or rectal adenocarcinoma
- Bacterial prostatitis
- Granulomatous prostatitis
- Amyloidosis

Q.2) Nodular prostate on PR examination

Coronal T2 weighted images show hypointense mass in the peripheral zone with sclerotic lesions in the pelvic bones suggesting Prostate cancer

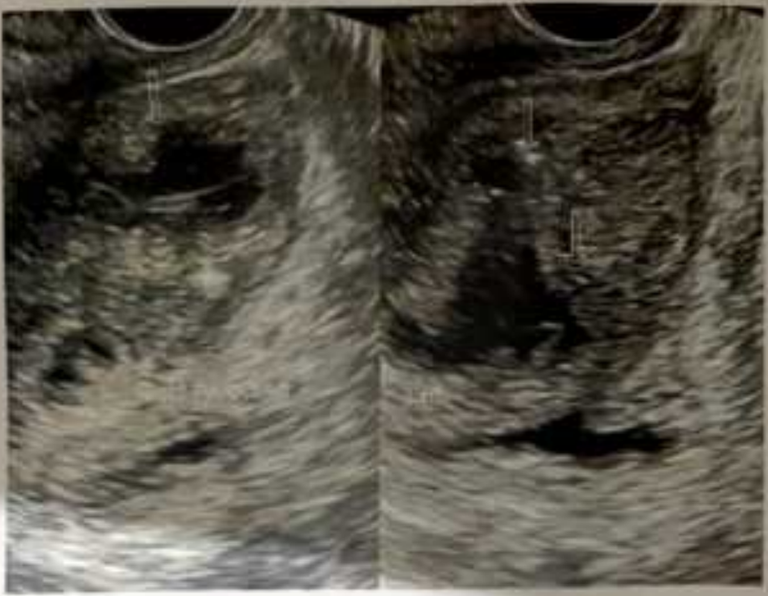


The MR spectroscopic evaluation is mainly based on the choline peak elevation and choline-creatinine ratios.
Choline/creatine to citrate ratios:
> 0.5: suspicious
> 0.8: very suspicious
> 2: abnormal



My ChoCrNaaLa (think of a new chocolate energy bar or something)
My: Myo-inositol 3.5
Cho: Choline 3.2
Cr: Creatine 3.0
Naa: Naa 2.0
L: Lactate 1.3

Q.3) Male.60. Dysurea



Identify: Transrectal Ultrasound (TRUS) Prostate with Grey Scale Images

Describe: Cystic spaces with ill-defined hypoechoic areas within an enlarged and/or distorted prostate gland. Extra-prostatic spread is noted on right side.

Diagnosis: Prostatic Abscess

What next:

- Contrast enhanced MRI
- MR spectroscopy
- Contrast Enhanced CT-tends to show well defined areas of low attenuation

MRI Signals:

- T1: hypointense
- T2: hyperintense
- C+ (Gd): tends to show peripheral contrast enhancement.

Treatment:

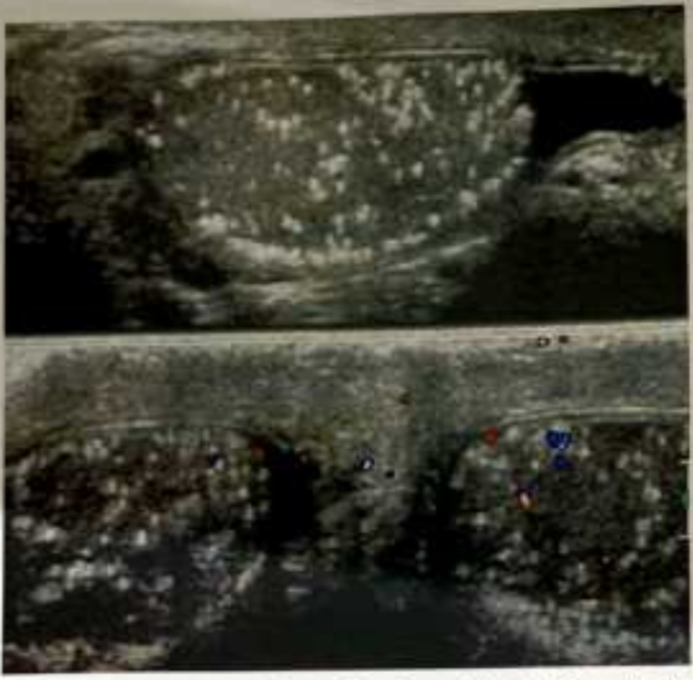
Percutaneous transperineal or transrectal drainage.

A TRUS guided aspiration

Differential diagnosis:

- Cavitatory prostatitis from chronic prostatitis
- Cystic prostatic carcinoma

Q.4) Testicular pain-50y/M (2017), (2016)



Identify: Scrotal Ultrasound Grey Scale and Color Doppler Images of bilateral testicles

Describe: Small non-shadowing hyperechoic foci ranging in diameter from 1-3 mm seen within the testicular parenchyma and distributed uniformly to center as well as periphery. The epididymides have normal sonographic appearances. No hydrocele. No varicocele

Diagnosis: Testicular micro-lithiasis-Grade IV

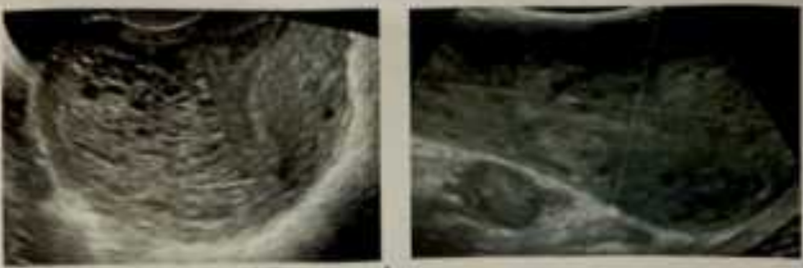
Seen with Klinefelters Syndrome, Criptorchid testes, Male pseudohermophordism, Testicular tumors

What next:

Annual ultrasound follow-up until age 55, only if a risk factor is present like

- personal/family history of germ cell tumour
- maldescent
- orchidopexy
- testicular atrophy

Q.5) Left testicular painless swelling **(2017)**



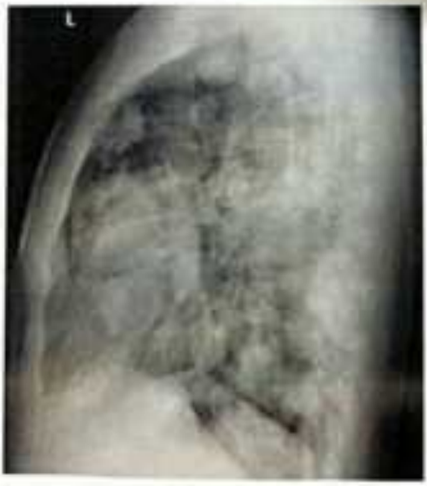
Identify: Scrotal Ultrasound
Grey Scale Image of testes

Describe: Mixed echotexture lesion within testis with both cystic and necrotic components and few internal calcific focci. The epididymides have normal sonographic appearances. No hydrocele. No varicocele

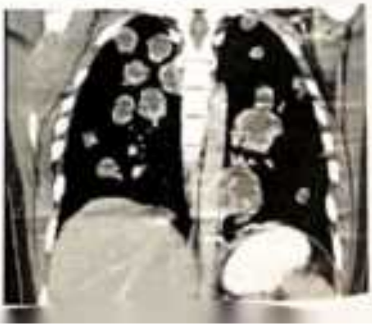
Diagnosis: Testicular choriocarcinoma

What next:

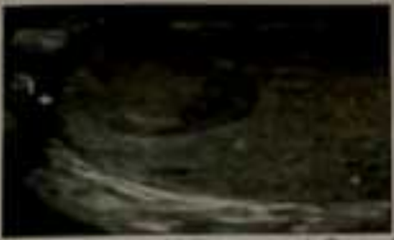
- CT Chest & Pelvis-cannon ball metastasis in lungs
- MRI

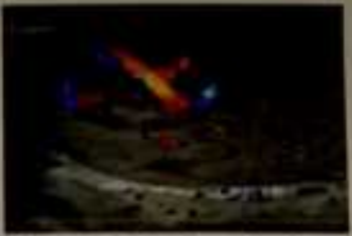


Cannon-ball metastases in lung



Q.6) Testicular pain-22y/M (2014)





Identify: Scrotal Ultrasound Grey Scale and Color Doppler Images of testicle

Describe: Within the upper portions of the left testicle, there is a well-defined lobulated hypoechogenic nodule that shows increased internal vascularity, but no cystic or calcified components. The testicles have overall normal size and vascularity, showing multiple microcalcifications foci, particularly on the left. The epididymides have normal sonographic appearances. No hydrocele. No varicocele

Diagnosis: Testicular seminoma

What next:

- CT to see metastases
- MRI
  T2: hypointense to normal testicular tissue
  T1+C (Gd): inhomogeneous enhancement
- **FDG-PET** following treatment of seminoma to look for metabolic activity within residual lymphadenopathy or extranodal metastases.

Treatment:

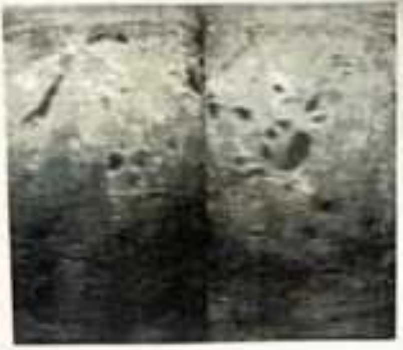
- Treatment involves surgical removal of the testicular primary (orchiectomy).
- Radiotherapy to regional nodes if there is local disease (stage I)

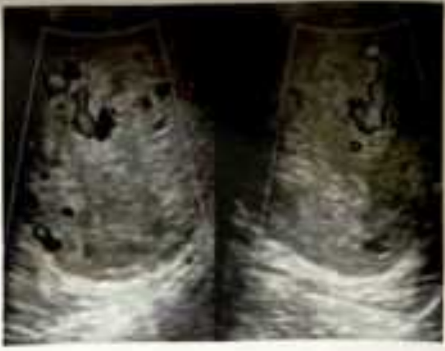
Differential Diagnosis:

- testicular teratoma
- testicular epidermoid (teratoma with ectodermal elements only)
- testicular choriocarcinoma
- testicular embryonal cell carcinoma
- testicular yolk sac tumour (endodermal sinus tumour)
- testicular mixed germ cell tumour

Q.7) Right scrotal swelling for last 60 days. Pain was present for the first few days but now painless-35Y-Male

(2013)



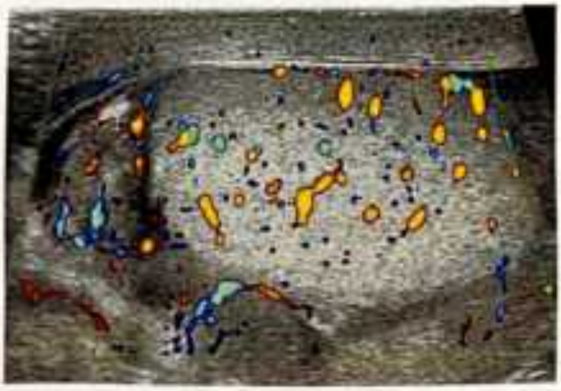


Identify: Scrotal Ultrasound Grey Scale and Color Doppler Images of testicle

Describe: Large diffusely mix echotexture mass lesion in right scrotal sac. Arterial and venous flow seen within the lesion. No hydrocele. No varicocele

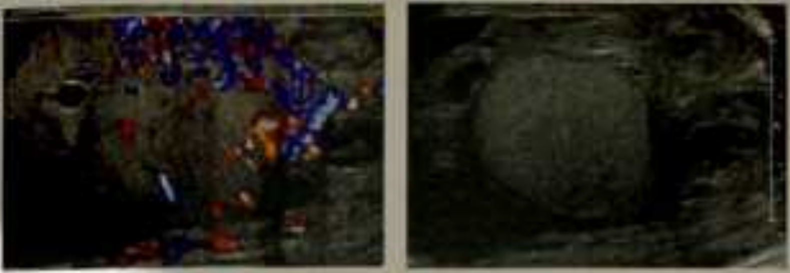
Diagnosis: Testicular teratoma

What next: CT is required to assess for nodal and distant metastatic disease.



Increased epididymal size with prominent vascularity of the right epididymis, consistent with epididymitis.

Q.8) Acute Scrotal pain (2017)



Identify: Scrotal Ultrasound Grey Scale and Color Doppler Images of testicle

Describe:

- There is increased scrotal wall thickening
- There is hyperaemic enlargement of the epididymis with focal regions of decreased or mixed echogenicity
- There is a nonvascular hypoechoic area surrounded with hypervascular epididymis and mildly increased flow in surrounding testis.
- Mild reactive hydrocele. No varicocele

Diagnosis: Epidydmo-orchitis

What next:

Pertechnetate scintigraphy can be used in evaluating the acute scrotum. Increased perfusion and uptake of the scrotal contents is characteristic of epididymo-orchitis.

Treatment:

- The vast majority of patients are managed with simple analgesia and oral antibiotics.

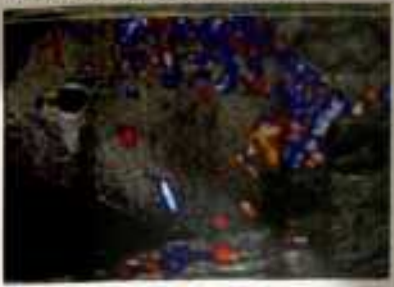
Complications

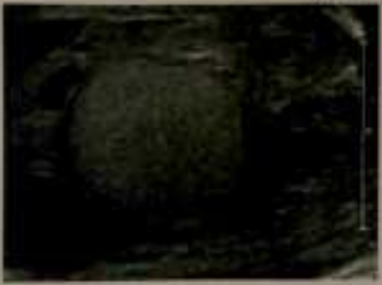
- vascular compromise due to increased intratesticular pressure resulting in testicular ischaemia and even infarction
- epididymal abscess
- testicular abscess

Differential diagnosis:

- isolated orchitis
- granulomatous epididymitis
- chronic epididymitis: enlarged epididymis with increased heterogeneous echogenicity
- testicular neoplasm: clinical presentation is usually different

Q.8) Acute Scrotal pain (2017)





Identify: Scrotal Ultrasound Grey Scale and Color Doppler Images of testicle

Describe:

- There is increased scrotal wall thickening.
- There is hyperaemic enlargement of the epididymis with focal regions of decreased or mixed echogenicity
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Complications

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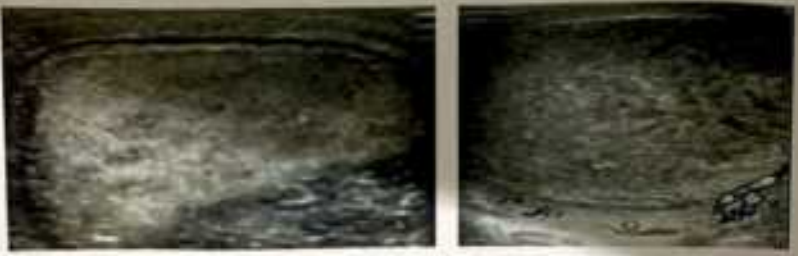
- testicular abscess

Differential diagnosis:

- isolated orchitis
- granulomatous epididymitis
- chronic epididymitis: enlarged epididymis with increased heterogeneous echogenicity
- testicular neoplasm: clinical presentation is usually different

Q.9) Left sided scrotal pain swelling for 12 days. **(2015)**



Identify: Scrotal Ultrasound Grey Scale and Color Doppler Images of testicl

Describe:

- Heterogeneous testicular parenchyma with absent flow as compared to normal testis (Normal testis image ll be present in exam)
- Peripheral testicular neovascularization/ flow seen.
- The size of testis is increased
- Mild reactive hydrocele
- Reactive thickening of the scrotal skin with hyperaemia and increased flow

Diagnosis: Testicular torsion

What next:

- Tc-99m pertechnetate
- Dynamic flow imaging at 2-5 second intervals for 1 minute in the vascular phase, 5-minute intervals for tissue phase

Treatment:

The key to successful treatment is rapid diagnosis and surgical intervention. If diagnosed early enough, the testis can be distorted with little damage. If the testis has necrosed, then orchidectomy is required.

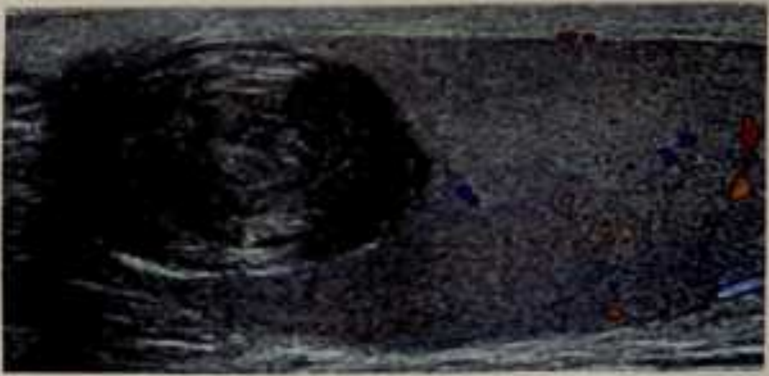
Likelihood of salvage of the testis:

<6 hours: 100% salvage
6-12 hours: 50%
12-24 hours: 20%

Differential diagnosis

- epididymo-orchitis
- testicular abscess
- testicular tumours
- torsion of the epididymal appendix
- testicular trauma

Q.11) (2018)



Identify: Scrotal Ultrasound Doppler Image of testicle Longitudinal Section

Describe: There is a well circumscribed intratesticular mass at the upper pole of the right testis. The mass contains alternating hyperechoic and hypoechoic rings, demonstrating a lamellar ("onion skin") or "whorled" appearance. There is no vascularity within the testicular lesion. The surrounding testis is normal.

Diagnosis: Intratesticular epidermoid cyst

What next:

MRI

- T1: overall signal can be variable; may show alternating rings of high and low signal
- T2: may a low-intensity rim 3; may also show alternating rings of high and low signal
- T1 C+ (Gd): typically no contrast enhancement

Treatment and prognosis

1. The lesion can be enucleated and frozen sections obtained to confirm the diagnosis.
2. Some authorities advocate orchiectomy
3. Others suggest organ-sparing surgery.

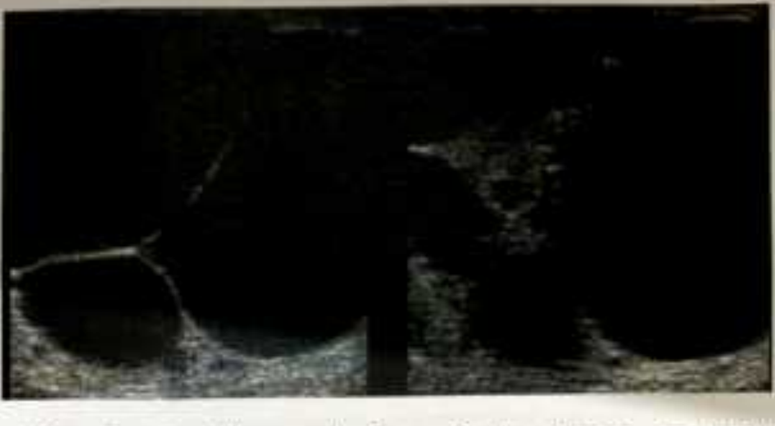
Differential diagnosis:

1. testicular germ cell tumour, e.g. seminoma: tends to show vascularity
2. testicular teratoma: overlap in appearance
3. tunica albuginea cyst: tends to be completely anechoic
4. focal intratesticular granulomatous disease, e.g tuberculosis
5. focal testicular haemorrhage

✓

Q.12) Scrotal pain and enlargement of the scrotum.

(2014)



Identify: Scrotal Ultrasound Grey Scale Image of testicle Longitudinal Section

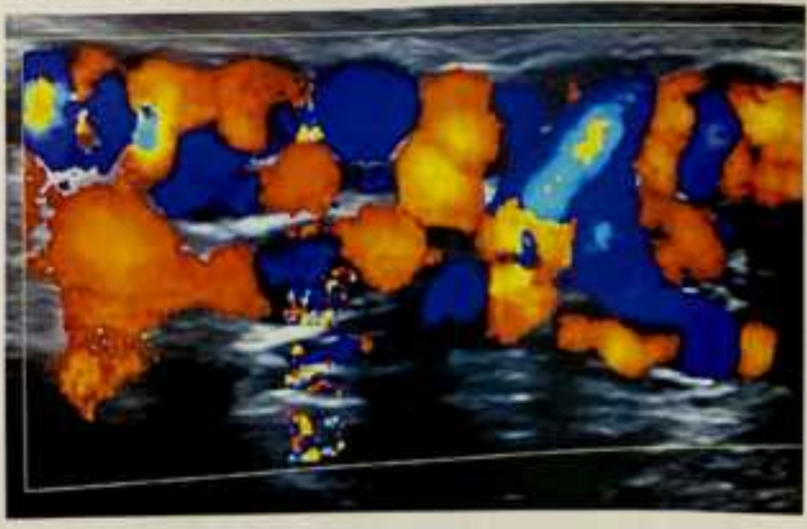
Describe: Rete testis tubular ectasia in both testes. No Doppler signals. Bilateral associated irregular cystic ares/epididymal hypoechoic lesions measuring 1-2 cm and demonstrating posterior acoustic enhancement with few fine low-level internal echoes. Testis showing normal parenchymal configuration.

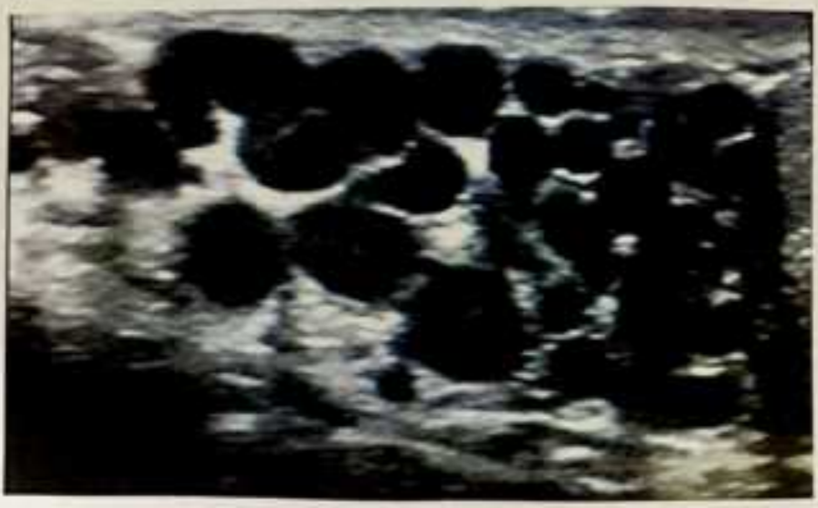
Diagnosis: Multilocular spermatocoele

Differential Diagnosis:

- Epididymal cyst
- tunica vaginalis cyst
- paratesticular abscess
- small hydrocoele to be differentiated from large epididymal cyst with septations

Q.13) Left paratesticle pain (2012) , (2015)





Identify: Scrotal Ultrasound Grey Scale and Color Doppler Images of testicle Longitudinal Section

Describe: Multiple dilated serpiginous vessels superior to the upper pole of the testicle-pampiniform plexus of veins, a network of many small veins. Maybe measuring more then 2-3mm. Avid doppler flow within.

Normal right hemiscrotum.

Diagnosis:
What next:
Infertility Workup-Semen Analysis
CT-may show a dilated cluster of enhancing serpentine veins
MRI

- signal intensity depends on velocity of flow
- low flow: intermediate T1 and high T2
- high flow: signal void
- enhancement following gadolinium administration

Angiography

- Venography, only performed during endovascular treatment, may demonstrate
- dilated testicular veins
- retrograde flow of contrast towards the scrotum
- dilated pampiniform plexus should not be directly imaged

Treatment:

- Embolisation of testicular vein
- Surgical ligation of testicular vein

The left side testicle is affected much more commonly than the right

Grading of varicocele
Grade 1

- no dilated intrascrotal veins
- reflux in spermatic cord veins of the inguinal region during Valsalva maneuver

Grade 2

- prominent veins at upper pole of testis
- reflux at upper pole veins during Valsalva maneuver

Grade 3

- no major dilatation in supine position
- dilated veins upto lower pole of testis seen only in standing position
- reflux at lower pole veins during Valsalva maneuver

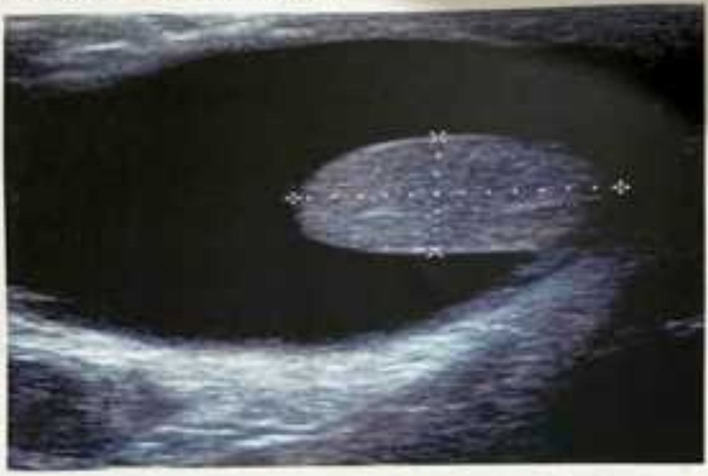
Grade 4

- dilated veins even in supine position
- reflux during Valsalva maneuver

Grade 5

- dilated veins
- reflux without Valsalva maneuver

Q.14) Painless scrotal swelling (2010)



Identify: Scrotal Ultrasound Grey Scale Images of testicle Longitudinal Section

Describe: Simple clear fluid collection seen within scrotal sac with no septations seen. The testicles have normal size and parenchyma. The epididymides have normal sonographic appearances. No varicocele

Diagnosis: Hydrocoele

What next:

MRI

- T1: low signal
- T2: high signal

This represents the simple serous fluid component of the hydrocele.

Treatment:

In infants, most hydroceles (around 90%) resolve spontaneously

Differential diagnosis

- spermatocele
- pyocele
- haematocele
- inguinoscrotal hernia
- scrotal cystocele

Intravenous urography

Intravenous urography (IVU), also referred as intravenous pyelography (IVP) or excretory urography (EU), is a radiographic study of the renal parenchyma, pelvicalyceal system, ureters and the urinary bladder. This exam has been largely replaced by CT urography.

Indications

1. check for normal function of kidneys
2. check for anatomical variants or congenital anomalies (e.g. horse-shoe kidney)
3. check the course of the ureters
4. detect and localise a ureteric obstruction (urolithiasis)
5. assess for synchronous upper tract disease in those with bladder transitional cell carcinoma (TCC)

Patient preparation

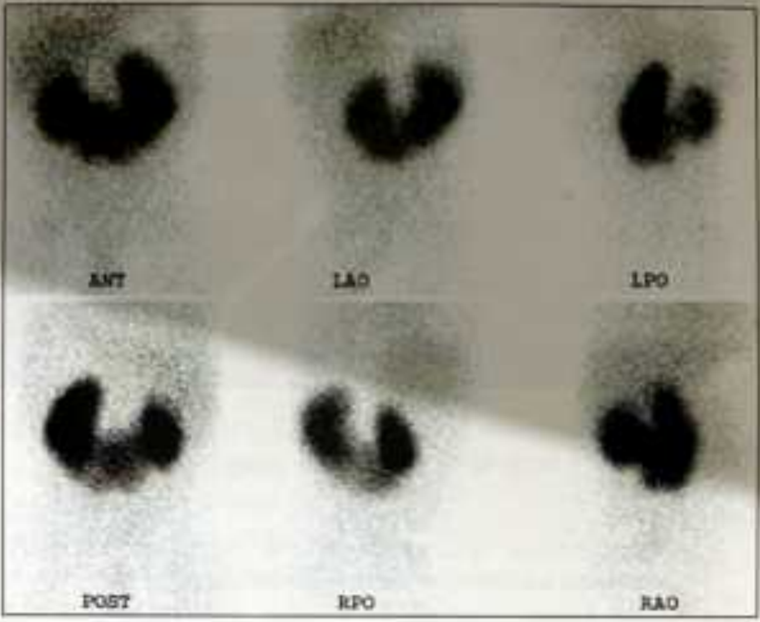
- overnight fasting prior to the date of examination; a laxative would help to achieve a good preparation
- on the day of procedure take a scout/pilot film to check patient preparation and also for radio-opaque calculi
- check serum creatinine level to be within normal range (as per hospital guidelines)
- take a history of the patient for any known drug allergies followed by a written informed consent for the procedure

Technique

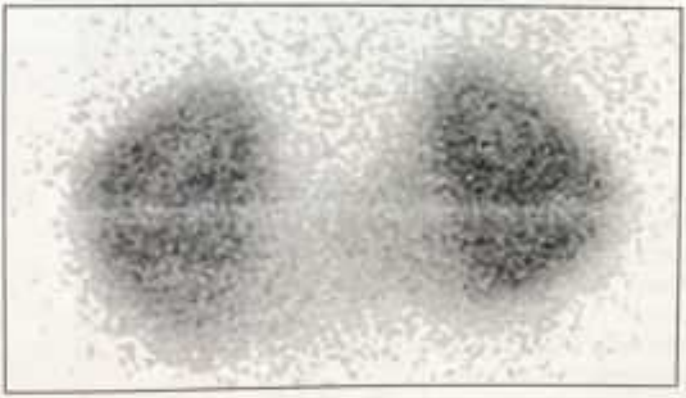
- IV access is required for administration of a water-soluble contrast
- nonionic contrast is preferred
- Generally up to 1.5 ml/kg body weight is well tolerated by patient

1. scout images
2. nephrogram (1-2 minutes)
3. early and late images of the upper collecting system (abdominal compression then applied) (>3 minutes)
4. tomography may be obtained, if desired
5. supine, after release of compression, images of the upper collecting system and proximal ureters (10-15 minutes)
6. supine image (20 minutes)
7. prone image (20 minutes)
8. lastly take a full bladder and post void film

- ✧ compression should not be applied if ureteral calculi, ureteral obstruction, recent surgery, nephrostomy, or abdominal aortic aneurysm is suspected

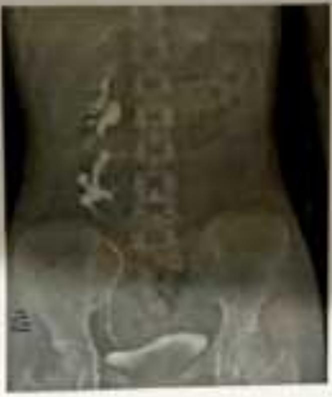


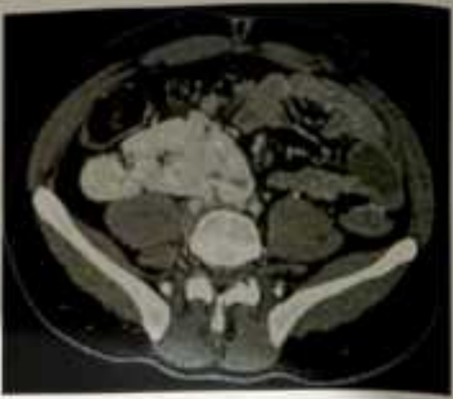
DMSA nuclear scan showing Horseshoe kidney.



Tracer uptake into both left and right kidneys. Tracer is also demonstrated between the two kidneys in an isthmus of a horseshoe kidney.

Q.16) Right abdominal pain (2016)





Identify: Intravenous urography (IVU), Intravenous pyelography (IVP), Excretory urography (EU) Prone Image

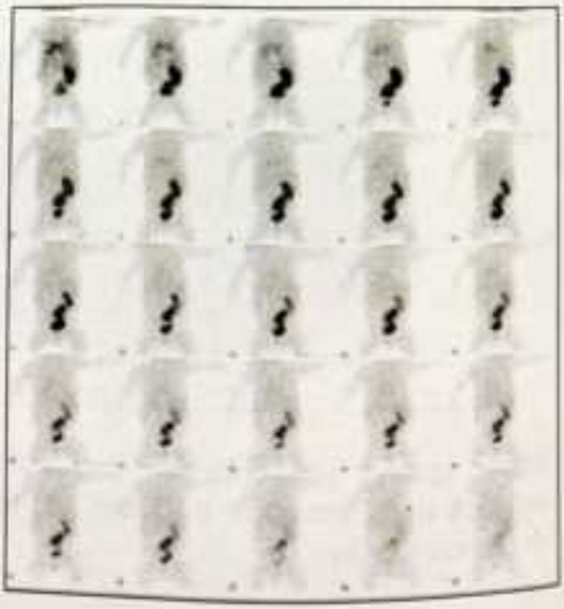
Describe:

- Both kidneys are seen on the right side (fused) with adequate excretion of contrast medium
- Right ureter: normal in course and caliber and opens normally in orthotopic position
- Left ureter: short, non-tortuous, normal caliber and crosses to the left side and inserts orthotopically.

CT: Both kidneys are seen in the right iliac region, where the left kidney is crossed and fused with the right one, showing fused upper and lower poles of both, forming a pancake shaped kidney. Both right and left adrenal glands are present and seen in their normal anatomical location.

Diagnosis: Crossed fused renal ectopia

What next: The blood supply to cross-fused kidney is usually anomalous and



angiography recommended before surgical intervention.

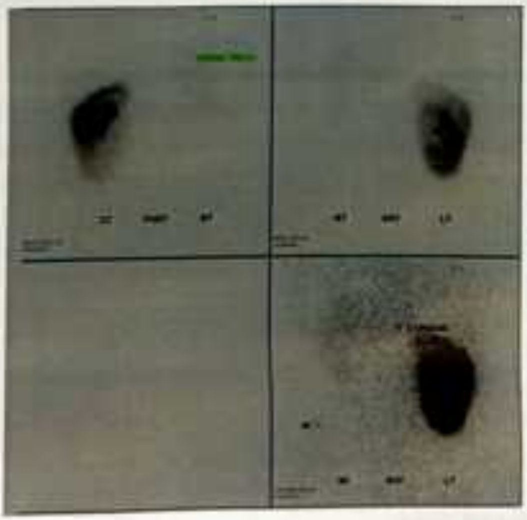
Complications:

4. hydronephrosis (due to UPJ obstruction)
5. infection
6. calculi
7. increased incidence of malignancy (Wilms, transitional cell and carcinoid tumours)
8. increased susceptibility to trauma

Subtypes

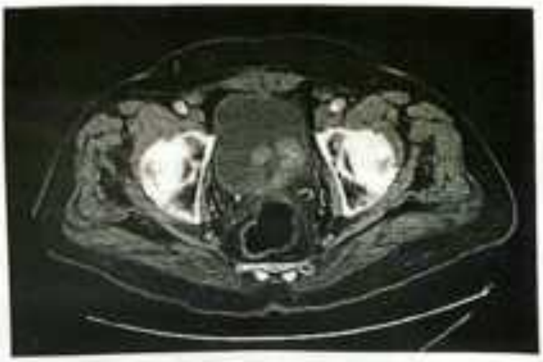
- type a: inferior crossed fusion
- type b: sigmoid kidney
- type c: lump kidney
- type d: disc kidney
- type e: L-shaped kidney
- type f: superiorly crossed fused

5



Crossed fused renal ectopia on Nuclear DMSA Scan

Q.17)



CT

- Bladder transitional cell carcinomas appear as either focal regions of thickening of the bladder wall, or as masses protruding into the bladder lumen, or in advanced cases, extending into adjacent tissues. Care should be taken in assessing bladder wall thickness as this changes with the degree of bladder distension and varies from patient to patient, e.g. patients with bladder outlet obstruction due to benign prostatic hypertrophy. In general, however, asymmetric mural thickening should be viewed with suspicion.

CT or conventional urography

- Urography's primary role is in the assessment of the remainder of the urinary tract for transitional cell carcinomas of the renal pelvis or ureter. When tumours are large and of papillary morphology, contrast filling the interstices between papillary projections can lead to a dappled appearance referred to as the stipple sign.

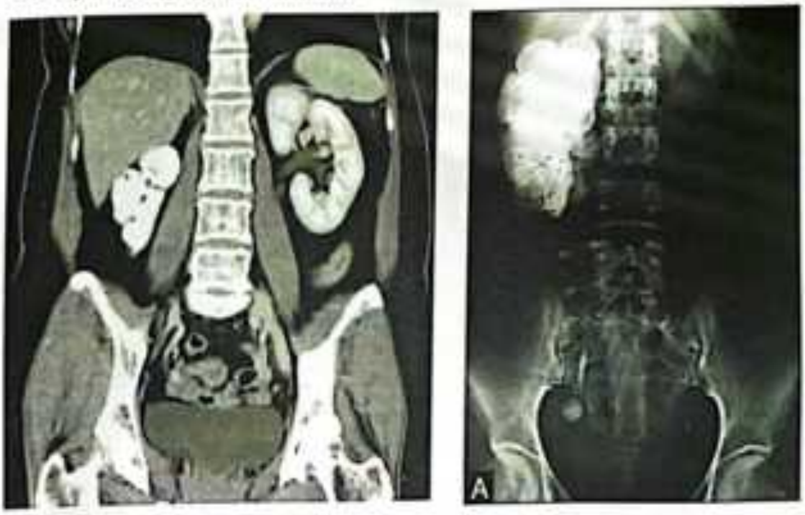
MRI

- T1: isointense compared to muscle 4
- T2:slightly hyperintense compared to muscle,useful in determining the low signal muscle layer and its discontinuity when muscle wall invasion
- T1 C+ (Gd): shows enhancement

Differential diagnosis:

- squamous cell carcinoma of the bladder
- adenocarcinoma of the bladder
- benign prostatic hypertrophy/prostate cancer

Q.18) History of ATT intake (2015)



Identify: Plain Radiograph KUB Frontal Projection & Enhanced CT (Renal Parenchymal Phase) Coronal image Sections of Abdomen & Pelvis

Describe: Shrunken right kidney with extensive amorphous calcification and lobular margins

Diagnosis: This case demonstrates end stage renal tuberculosis (also known as TB auto nephrectomy) resulting in the so-called Putty kidney.

What next: Multi-drug treatment, Nephrectomy, partial nephrectomy or cavernostomy can be performed both open and endoscopically

Fluoroscopy

- parenchymal scars 50%
- moth eaten calyces: early finding
- irregular caliectasis
- phantom calyx
- hydronephrosis

Lower urinary tract signs

- Kerr kink
- sawtooth ureter
- pipe-stem ureter
- beaded or corkscrew ureter
- thimble bladder

Ultrasound

Early

- normal kidney or small focal cortical lesions with poorly defined border
- +/- calcification

Progressive

- papillary destruction with echogenic masses near calyces
- distorted renal parenchyma
- irregular hypoechoic masses connecting to collecting system; no renal pelvic dilatation
- mucosal thickening +/- ureteric and bladder involvement
- small, fibrotic thick-walled bladder
- echogenic foci or calcification (granulomas) in bladder wall near ureteric orifice
- localised or generalised pyonephrosis

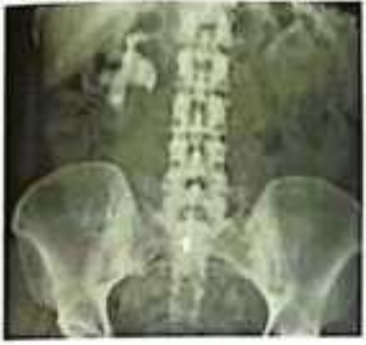
End-stage

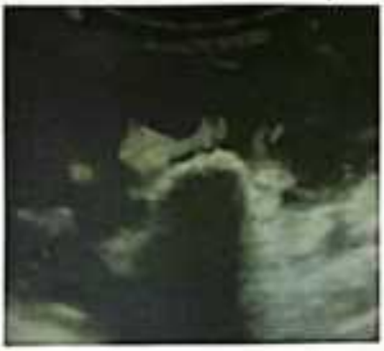
- small, shrunken kidney, "paper-thin" cortex and dense dystrophic calcification in collecting system
- may resemble chronic renal disease

Differential Diagnosis:

- papillary necrosis
- medullary sponge kidney
- TCC (transitional cell carcinoma) of renal tract
- SCC (squamous cell carcinoma) of renal tract
- xanthogranulomatous pyelonephritis (XGP)

Q.21) Admitted with flank pain and fever
'Bear's paw' appearance of dilated fluid filled spaces in the kidney with a central staghorn calculus (2016)





Cystography

Cystography is a fluoroscopic study that images the bladder. It is like a voiding cystourethrogram (VCUG), and the difference between the studies is primarily one of emphasis; a cystogram focuses on the bladder and a VCUG focuses on the posterior urethra. The study has been adapted to CT with a CT cystogram.

Indications

- dysfunctional voiding
- bladder outlet obstruction
- hematuria
- trauma
- fluoroscopic and CT cystography are considered equivalent in the emergent setting 3
- congenital anomalies of the genitourinary tract
- postoperative evaluation of the urinary tract

Technique

- Insert Foley catheter in bladder, or use an indwelling Foley or suprapubic catheter
- introduce water soluble contrast through the catheter (such as Isovue-300 or Cystografin)
- If looking for a bladder leak after trauma, fill to detrusor contraction or to at least 300 ml .
- If looking for a postoperative injury, then fill to a smaller volume (100-150 ml) or until resistance is felt
- avoid overfilling, so as not to blow out an anastomotic suture

- to try to ensure a destrusor contraction, try to have the patient void, if possible.

The following projections should be acquired keeping within the ALARA principle:

1. AP scout image
2. AP early filling images (if injury or postoperative evaluation, focus on those areas).
3. AP and steep obliques of the bladder (try to include the area of where the UVJ would be).
4. Postvoid radiograph

VCUG/MCU vs RUG/ASU

- While the urethra is well outlined in both procedures
- RUG/ASU is better to visualise anterior urethral abnormalities
- VCUF is better for posterior urethral abnormalities.
- Additionally VCUG is carried for detection of bladder abnormalities and vesico-ureteric reflux (VUR).

Voiding cystourethrography

Voiding cystourethrography (VCUG), also known as a micturating cystourethrography (MCU), is a fluoroscopic study of the lower urinary tract in which contrast is introduced into the bladder via a catheter. The purpose of the examination is to assess the bladder, urethra, postoperative anatomy and micturition to determine the presence or absence of bladder and urethral abnormalities, including vesicoureteral reflux (VUR).

It is more commonly performed in the paediatric population than adults.

Indications

1. urinary tract infection
2. dysuria
3. dysfunctional voiding
4. hydronephrosis and/or hydroureter
5. bladder outlet obstruction
6. haematuria
7. trauma
8. incontinence

9. neurogenic dysfunction of the bladder, e.g. spinal dysraphism
10. congenital anomalies of the genitourinary tract
11. postoperative evaluation of the urinary tract

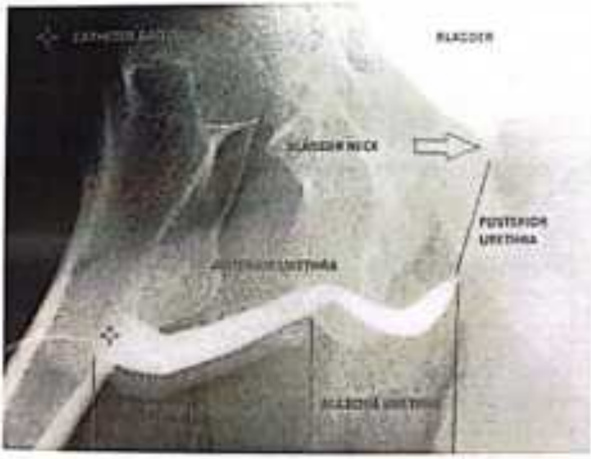
Technique

- The bladder is filled with contrast using an infant feeding tube under aseptic precautions; a Foley catheter can be used for older children
- Intermittent screening of the patient on fluoroscopy, while distending the bladder with contrast, is necessary to check for a ureterocele or VUR
- After the bladder is filled to its capacity (which will vary as per age of patient) the patient is now asked to void

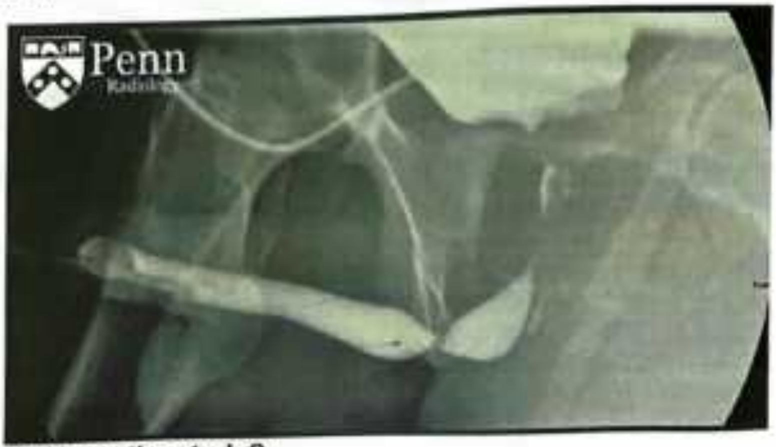
The following projections should be acquired keeping within the ALARA principle:

1. AP with full bladder for demonstration of the presence or absence of VUR.
2. both obliques to demonstrate bilateral vesicoureteric junctions.
3. post void film to check for a ureterocoele.

Anatomy of the normal ureter on ascending urethrogram.



Q.22) (2014)



Q.1) Name the study?

- Retrograde urethrogram, oblique spot film.

Q.2) What's the other name for it?

- Cystography

Q.3) What material is used?

- Foley catheter

Q.4) Where do you place the balloon?

- Inside urinary bladder

Q.5) Which contrast is used?

- Water soluble contrast through the catheter (such as Isovue-300 or Cystografin)

Q.6) Findings?

- Urethral strictures

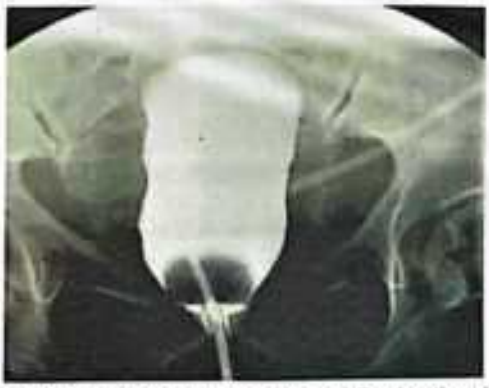
Q.7) Comment on the Anterior urethra?

- Long segment smoothly outlined non-stenotic narrowing in the bulbar urethra. Few air bubbles are present close to the Foley catheter balloon.

Q.8) What you will do for posterior urethra?

- Voiding cystourethrogram (VCUG)
- The posterior urethra is normal. No leak or stricture. The vesicourethral junction and anastomosis funnels normally during voiding. No post void residual. The bulbar urethra stricture can be seen, but is not as well evaluated as on the retrograde/ascending urethrogram.

Q.23) Trauma **(2017)**



Identify:
Retrograde Urethrogram/Cystogram Frontal Projection image

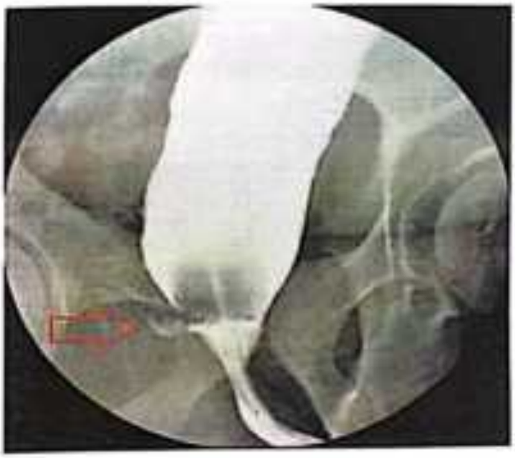
Describe: On the scout image, a left-approach soft tissue drain is visible. No pelvic fracture.

The bladder has a vertical "pear-shaped" configuration. The walls do not appear trabeculated. There is bilateral mass effect on the bladder, likely from a pelvic hematoma.

A small bladder neck leak is seen.

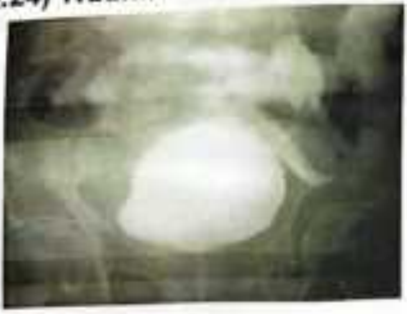
Diagnosis: Bladder base injury with contrast leaking out of the right bladder neck

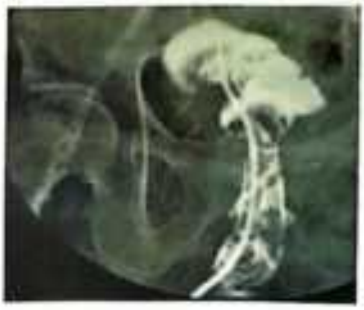
What next: The catheter should be left in place to decompress the bladder and aid in recovery of the bladder neck injury.



Q.24) Trauma

(2012)





Identify: Retrograde Urethrogram/Cystogram Frontal & Lateral Oblique Projection images

Describe: The bladder partially distended and the bladder wall appear irregular. Contrast appears to leak into the intraperitoneal space, between mesenteric folds and in the paracolic gutters, outlining bladder loops.

Diagnosis: Intraperitoneal bladder rupture

What next: Treatment is surgical repair.

Intraperitoneal bladder rupture can be differentiated from extraperitoneal bladder rupture, if contrast outlines loops of bowel. Oblique images may also be helpful in differentiating the two, although localization using the normal positions of pelvic structures could be misleading in a postoperative pelvis.

Appearances vary with the site of injury:

Bladder contusion

- normal

Subserosal bladder rupture

- elliptical extravasation of contrast around the bladder

Intraperitoneal

- usually bladder dome rupture
- contrast in paracolic gutters and between loops of small bowel

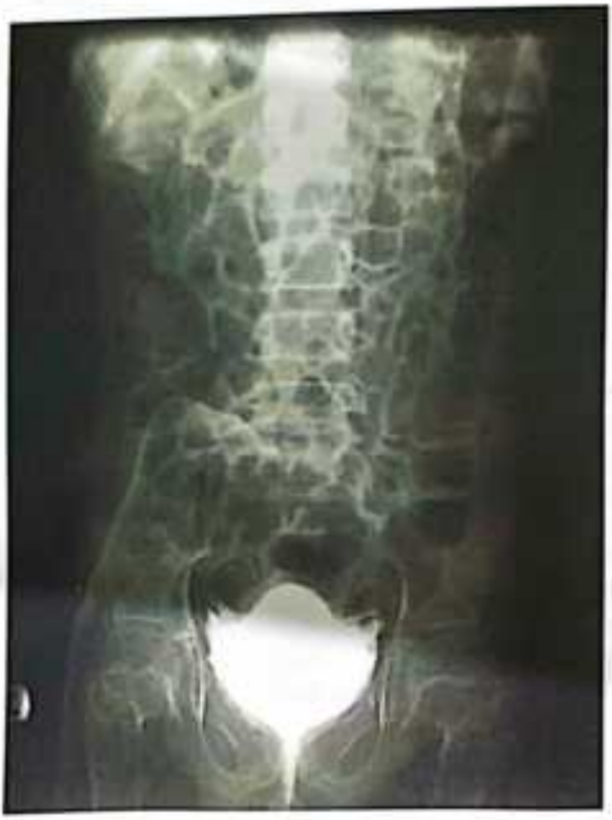
Extraperitoneal

- usually at bladder base anterolaterally
- extraluminal contrast into perivesical space (simple)
- molar tooth sign
- extension of extraluminal contrast to the thigh, scrotum or perineum (complex)

Combined

- mixed features of intraperitoneal and extraperitoneal rupture

Q.25) Cerebral palsy patient with blunt abdominal trauma, paralytic ileus and hematuria (2015)



Identify: Post Void Cystogram Frontal Projection image

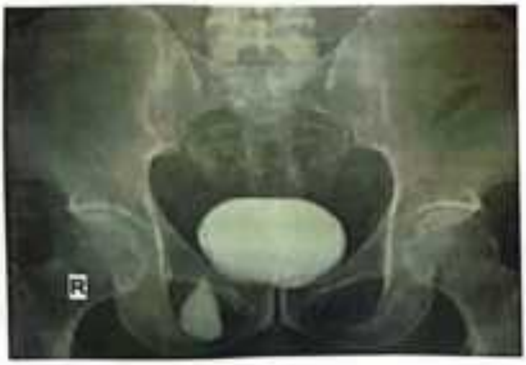
Describe: Flame-shaped density adjacent to lateral walls of bladder representing extra-peritoneal contrast from a bladder rupture-molar tooth sign

Diagnosis: Extraperitoneal bladder rupture

What next: Treatment is with an indwelling catheter (IDC/Foley). The catheter should be left in place to decompress the bladder.

Extension of extraluminal contrast to the thigh, scrotum or perineum **(complex cases)**

Q.26) **(2016)**



Identify: Cystogram Spot Image Frontal projection

Describe: Partially visualized bladder base on right side. Contained Tear drop like contrast filled area projecting over right obturator foramen

Diagnosis: Urinary bladder hernia

What next:

IVU-For upper track abnormalities

Retrograde cystography

CT: Pointing of the bladder toward the side of the hernia, i.e. angulation of the bladder base anteroinferiorly, is the CT sign of bladder herniation.

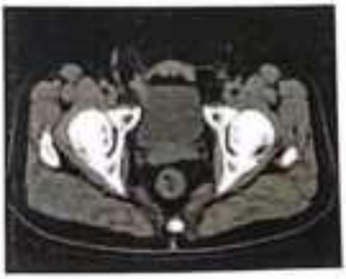
Ultrasound: A fluid-filled sac in continuity with the urinary bladder is seen.

MRI: Coronal and sagittal planes can help a lot.

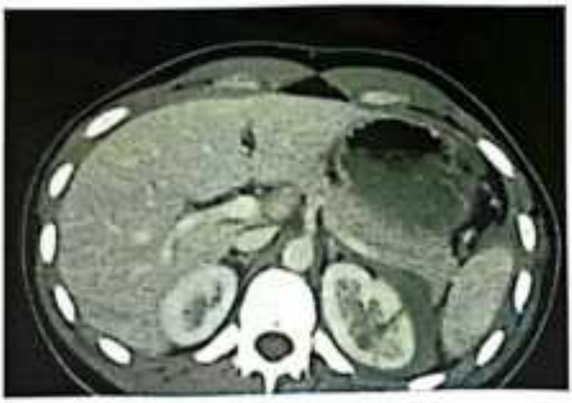
Differential Diagnosis:

1. Bladder ears: In young infants, normal protrusion of the lateral aspect of the bladder into the inguinal canal
2. Cystocele: are usually triangular and along the midline, whereas bladder hernias are projected laterally
3. Urinary bladder diverticulum
4. Ureteral Hernia

Right inguinal hernia containing urinary bladder.



Q.27) RTA **(2016)**



Identify:

Contrast enhanced CT Abdomen Renal Parenchymal Phase Soft Tissue Window Axial Section Image at Level of Upper Poles of Kidney

Describe: A linear or wedge-shaped opacification defects that are particularly evident in the nephrographic phase, may have a depth < 1 cm (grade II) or > 1 cm (grade III) without involvement of the collecting system

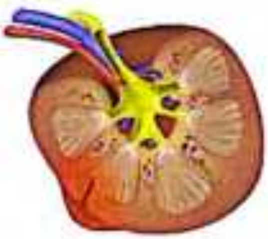
There is associated perirenal hematoma, a hyperattenuating fluid in the perinephric fat.

Diagnosis: Traumatic Renal Laceration (Grade II-III of AAST)

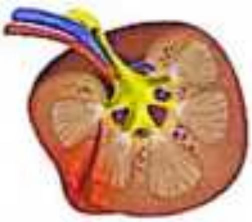
What next:

1. Inform physician.
2. Delayed renal excretory phase imaging of abdomen pelvis to exclude collecting system/ ureteric leak.
3. Look for additional visceral injuries and bone window for fractures

Grade 2



Grade 3



Classification

Grade I: contusion or non-enlarging subcapsular perirenal haematoma, and no laceration

Grade II: superficial laceration <1 cm depth and does not involve the collecting system (no evidence of urine extravasation), non-expanding perirenal haematoma confined to retroperitoneum

Grade III: laceration >1 cm without extension into the renal pelvis or collecting system (no evidence of urine extravasation)

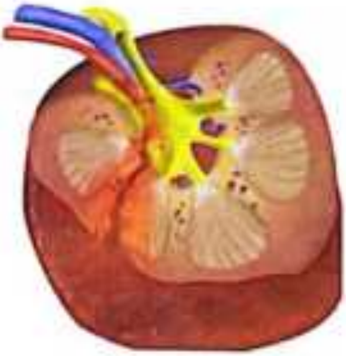
Grade IV

- laceration extends to renal pelvis or urinary extravasation
- vascular: injury to main renal artery or vein with contained haemorrhage
- segmental infarctions without associated lacerations
- expanding subcapsular haematomas compressing the kidney

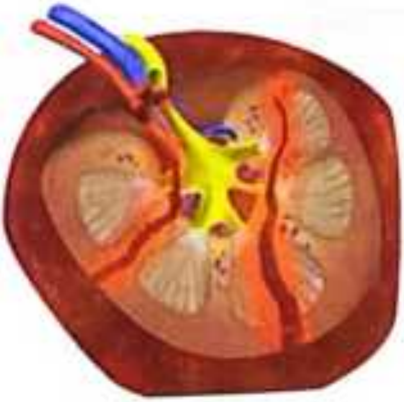
Grade V

- shattered kidney
- avulsion of renal hilum: devascularisation of a kidney due to hilar injury
- ureteropelvic avulsions
- complete laceration or thrombus of the main renal artery or vein

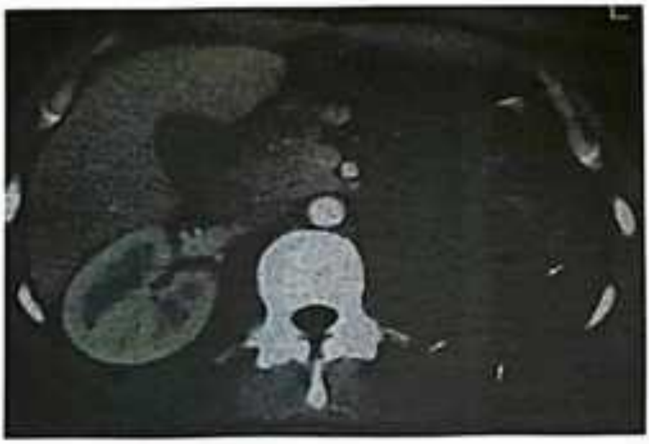
Grade 4



Grade 5



Q.28) Deceleration abdominal trauma; hematuria and pain



Identify: Contrast enhanced CT Abdomen Renal Parenchymal Phase Soft Tissue Window Axial Section Image at Level of Upper Poles of Kidney

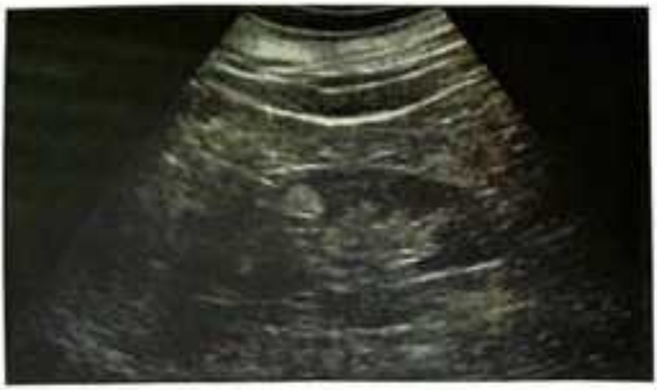
Describe: Defect of enhancement of Right renal artery and the absence of nephorografic effect on the right during the nephrographic phase

Diagnosis: Renal artery thrombosis

What next: Inform Physician, DSA (Angiography), **2.**Delayed renal excretory phase imaging of abdomen pelvis to exclude collecting system/ ureteric leak.

3. Look for additional visceral injuries and bone window for fractures

Abdominal pain



Identify: Grey Scale Ultrasound Abdomen Transverse Section Image of Kidney

Describe: A 1-2cm hyperechoic lesions located in the cortex of kidney with posterior acoustic shadowing

Diagnosis: Renal angiomyolipoma

What next:

CT-Most lesions involve the cortex and demonstrate macroscopic fat (less than -20 HU)

MRI-MRI is excellent at evaluating fat-containing lesions

DSA-Angiography-Angiomyolipomas are hypervascular lesions:

arterial phase: a sharply marginated hypervascular mass with a dense early arterial network, and tortuous vessels giving the "sunburst" appearance

venous phase: whorled "onion peel" appearance of peripheral vessels

Association:

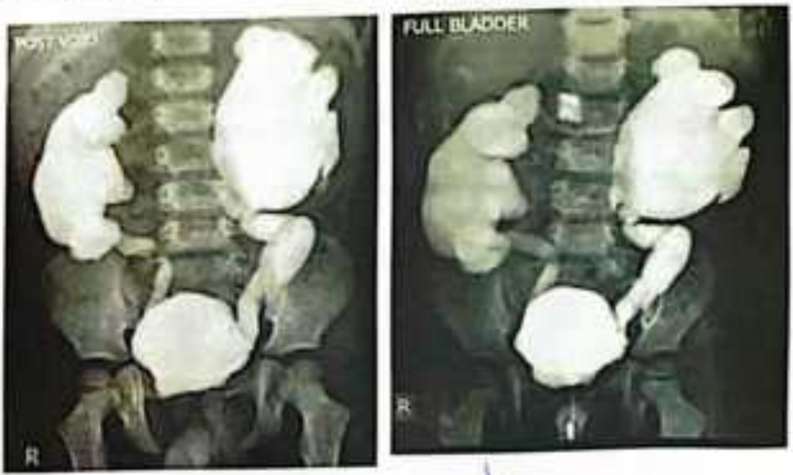
- Phakomatoses
- Tuberous sclerosis
- Von Hippel-Lindau syndrome (VHL)
- Neurofibromatosis type 1 (NF1)

Differential Diagnosis:

- Retroperitoneal liposarcoma invading the kidney:
- Adrenal myelolipoma
- Renal cell carcinoma (RCC)
- Oncocytoma: may contain fat
- Wilms tumour: may contain fat

Q.29) History of fever and recurrent urinary tract infections. 3Year/Male

(2015), (2018)



Identify: Micturating cystourethrogram

Describe:

- On filling of bladder with contrast passive reflux noted
- On micturating film active reflux noted
- Bilateral ureters appear dilated and tortuous
- Bilateral pelvicalyceal systems appear grossly dilated with loss of papillary impressions

Diagnosis: Bilateral Grade V vesicoureteric reflux (VUR)

What next:

Ultrasound: Ultrasound has been investigated as a replacement for traditional fluoroscopic voiding cystourethrogram, by assessing the distal ureters during bladder filling, using micro-bubbles

Nuclear medicine: Reflux can also be graded, although less precisely, with nuclear cystography.

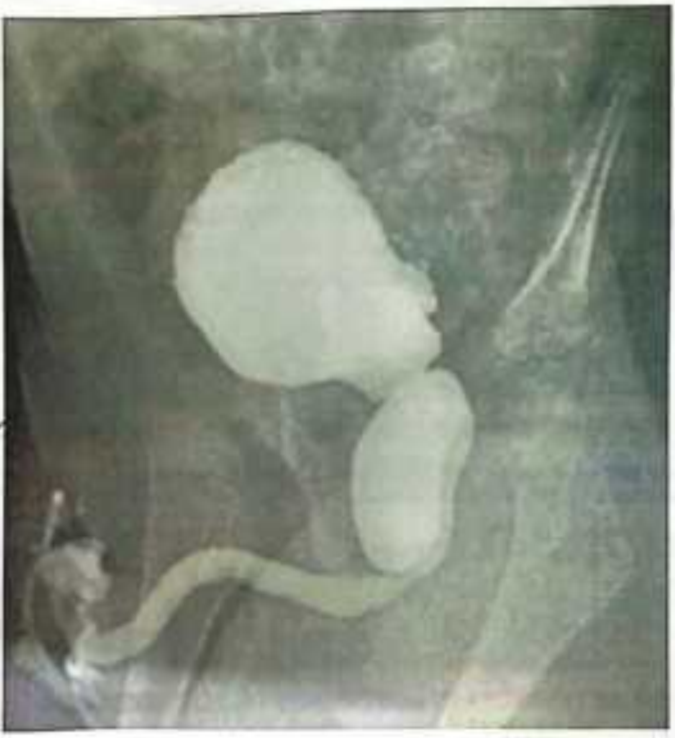
MRI: MR voiding cystourethrogram protocols are still being developed but have the advantage of not having ionising radiation and of simultaneously imaging the renal parenchyma.

Treatment:

Prompt prophylactic antibiotic treatment in low grades and surgical reimplantation in higher grades are aimed at reducing the risk of scarring and reflux nephropathy.

Q.30) (2016)

3-day old baby boy with hydronephrosis



Identify: Micturating cystourethrogram

Describe: Marked dilatation of the prostatic portion of the urethra along with bladder trabeculation

Diagnosis: Posterior urethral valves.

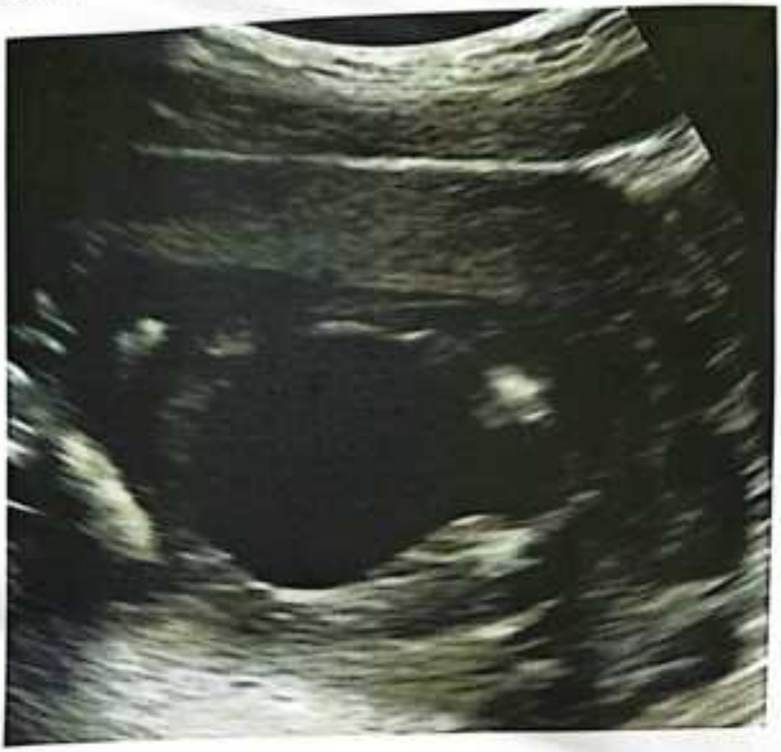
What next: Transurethral ablation of the offending valve

Associations: Down syndrome, Bowel atresia, Craniospinal defects

Differential Diagnosis:

- Neurogenic bladder
- Prune-belly syndrome

Q.31)



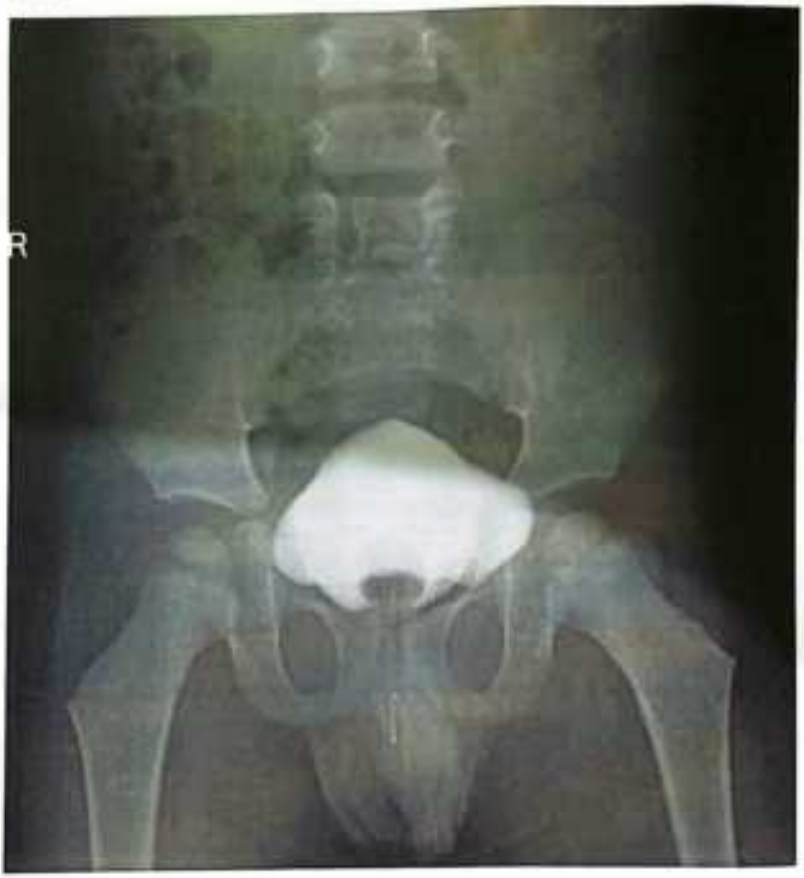
Identify: Grey Scale Antenatal ultrasound showing fetus pelvic region image

Describe: Markedly distended thick wall bladder and prostatic urethra (keyhole sign) with a degree of prominence of the renal collecting systems. Liquor is nearly absent.

Diagnosis: Posterior urethral valves.

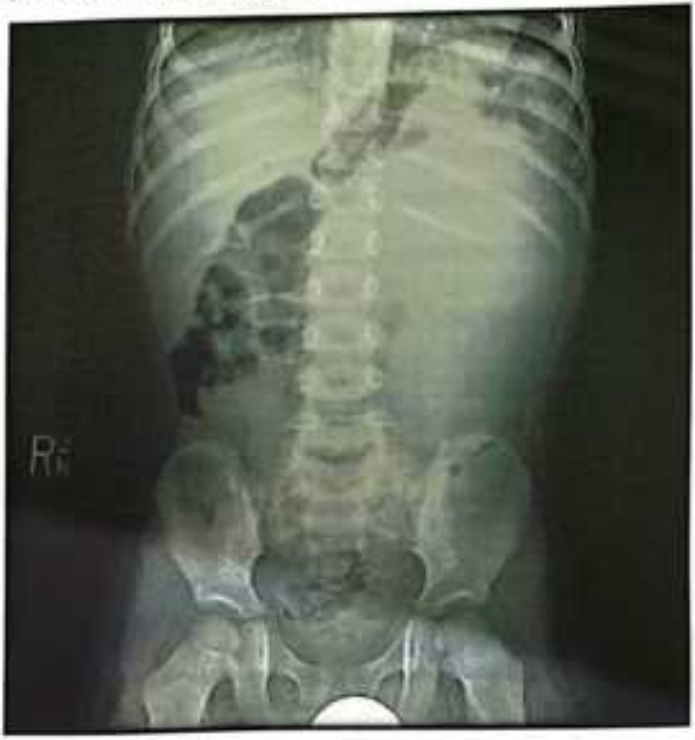
What next: Vesicoamniotic shunting (allowing urine to exit the bladder via the shunt, bypassing the obstructed urethra) Transurethral ablation of the offending valve

Q.32) Recurrent UTI-2 months-Male **(2015)**



VCUG shows 'bladder ears' (normal outpouchings seen in infants depicting projection of bladder into the inguinal canals) bilaterally, with asymmetric outpouching on left side (Hutch diverticulum).

Q.33) Abdominal swelling-4Y-Male (2014)



Identify: Plain Radiograph Abdomen & KUB Supine Projection
Describe: Large bean shaped soft tissue mass in the left renal area displacing the surrounding bowel loops and obscuring the left psoas muscle shadow. No internal calcifications.
Diagnosis: Wilm's tumor of left kidney
What next: Biopsy
Ultrasound: Ultrasound is a very useful examination and in almost every situation will be the primary investigation of choice. It is helpful to localise the mass to kidney and also distinguish from other causes of renal masses (e.g. hydronephrosis). Doppler examination can be performed to examine the renal vein and IVC to assess for the presence of tumour thrombus.
CT: Wilms tumours are heterogeneous soft-tissue density masses with infrequent areas of calcification and fat-density regions.
MRI: Where MRI is available it is the investigation of choice for staging

- T1: hypointense

- T1 C+ (Gd): heterogeneous enhancement
- T2: hyperintense

F-18 FDG PET/CT: is increasingly used as a problem-solving tool and to distinguish scar tissue from residual active tumour.

Treatment:

- Combination of nephrectomy and chemotherapy.
- Radiotherapy

Differential diagnosis:

1. Neuroblastoma
2. Clear cell sarcoma
3. Renal rhabdoid tumour
4. Renal abscess
5. Angiomyolipoma
6. childhood renal cell cancer (RCC)

Associations:

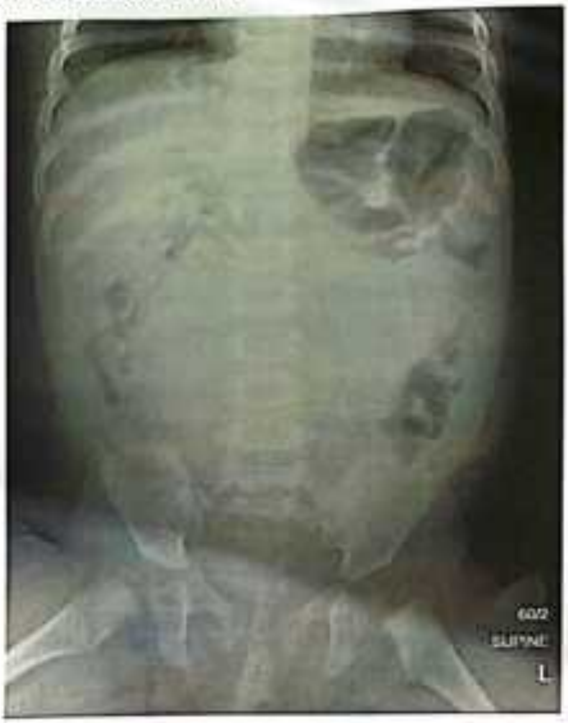
Overgrowth syndromes (WT2 gene):

1. Beckwith-Wiedemann syndrome
2. Perlman syndrome
3. Simpson-Golabi-Behmel syndrome
4. Sotos syndrome

Non-overgrowth syndromes (WTI gene):

1. WAGR syndrome
2. Denys-Drash syndrome
3. Isolated abnormalities:
4. Cryptorchidism
5. Hemihypertrophy
6. Hypospadias
7. Sporadic aniridia
8. Renal fusion

Q.34) Infant presenting with 24 hour history of urinary retention-4 months-Female (2013)



Identify: Plain Radiograph Abdomen & KUB Supine Projection
Describe: Marked abscenece of gas centrally and in the pelvis with displacement of bowel loops laterally. Appearances are suspicious for a pelvic mass and/or distended urinary bladder.
Diagnosis: Pelvic neuroblastoma
What next: MIBG
Ultrasound: demonstrates a heterogeneous mass with internal vascularity.
CT: The tumour typically is heterogeneous with calcifications seen in 80-90% of cases.
MRI: is superior to all other modalities in assessing the organ of origin
T1: heterogeneous and iso to hypointense
T2:

- heterogeneous and hyperintense
- cystic/necrotic areas very high intensity

- signal voids may be evident
- C+ (Gd): variable and heterogeneous enhancement

MIBG (metaiodobenzylguanidine labelled to Iodine-123)

Tc-99m MDP: to evaluate skeletal metastases

Treatment:

- Localised tumours considered to be 'low-risk' are surgically excised
- In 'high-risk' tumours, a combination or surgery, chemotherapy +/- bone marrow transplantation is employed

Differential diagnosis:

For an intra-thoracic neuroblastoma consider:

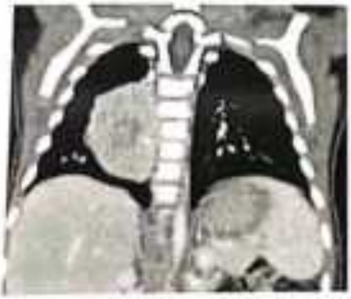
1. intrathoracic lymphoma
2. extralobar pulmonary sequestration
3. round pneumonia
4. ganglioneuroma
5. ganglioneuroblastoma

For an intra-abdominal neuroblastoma consider:

1. ganglioneuroma
2. ganglioneuroblastoma
3. rhabdomyosarcoma
4. Wilms tumour

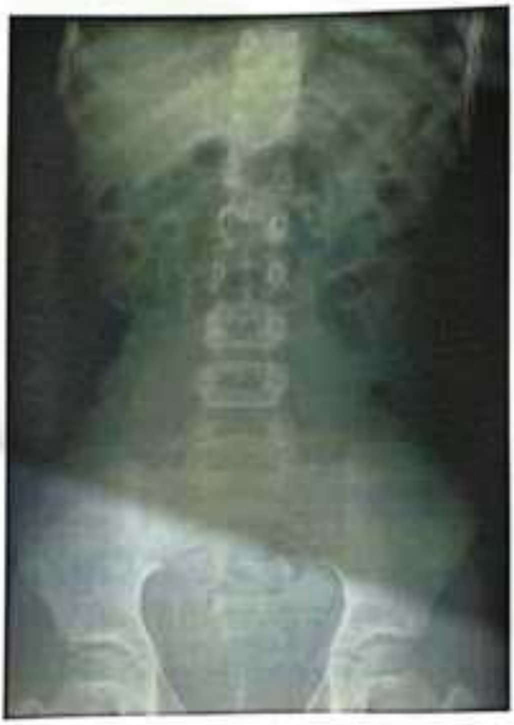
Associations:

1. Beckwith-Wiedemann syndrome
2. central failure of ventilation
3. DiGeorge syndrome
4. Hirschsprung disease
5. neurofibromatosis type 1



Large right enhancing mass with central hypoattenuation— Neuroblastoma

Q.35) Teratoma arising in the pelvis **(2015)**



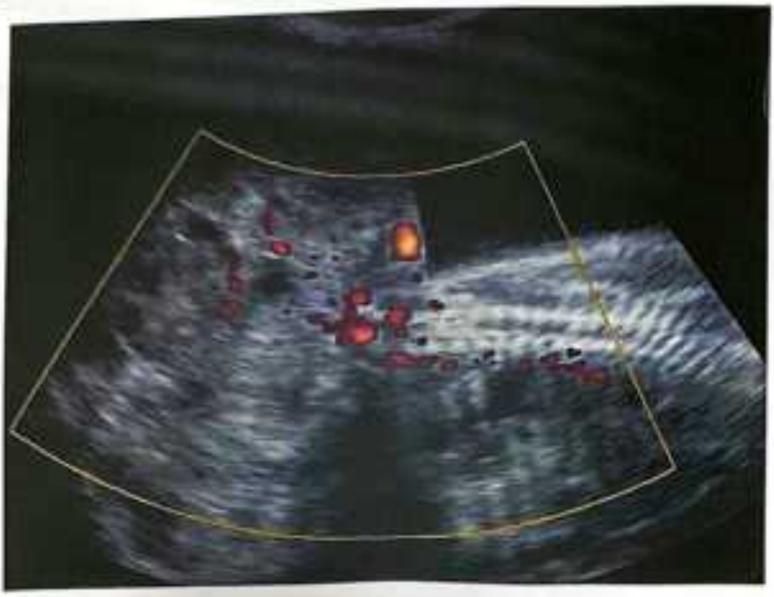
Large pelvic mass displacing bowel upwards-Sacrococcygeal teratoma

Complications

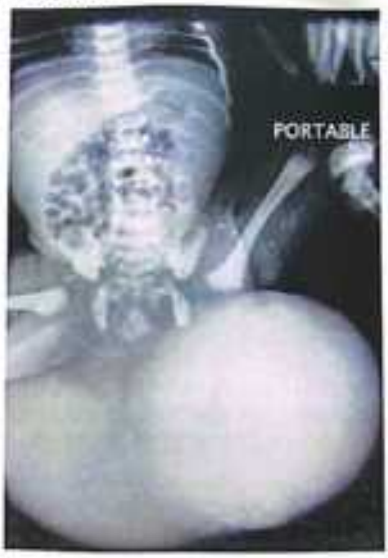
1. High output cardiac failure from AV shunting: which in turn can cause hydrops fetalis
2. Ureteric obstruction
3. Gastro-intestinal tract obstruction
4. Compression of underlying nerves: giving urinary/faecal incontinence
5. Anaemia
6. Dystocia
7. Tumour rupture

Differential diagnosis:

1. Sacral chordoma
2. Terminal myelocystocoele: for cystic types on ultrasound 9
3. Sacral meningocoele

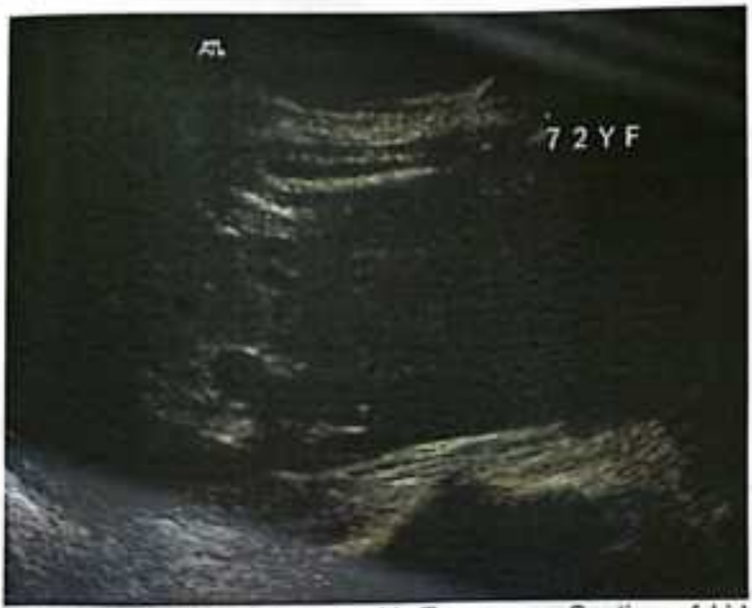


Ultrasound scan shows a 28-week male fetus with a huge solid hyper vascular buttock mass. The mass causes bilateral hydronephrosis in the fetus.



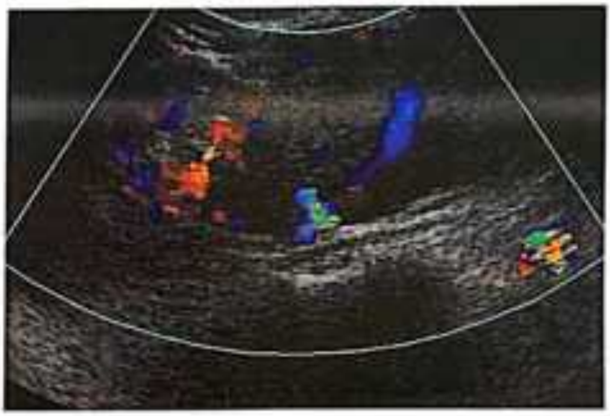
Large soft tissue swelling seen in the pelvic region

Q.36) Painless haematuria-70-Female



Identify: Ultrasound Abdomen with Transverse Section of kidney Grey Scale and Color Doppler Images

Describe: A large soft tissue mass appears to arise from / involve the lower pole of the left kidney. On color Doppler examination the mass demonstrates extensive internal vascularity. Additionally, an anechoic 2cm lesion is present in the upper pole, without solid component.



Diagnosis: Renal cell carcinoma

What next:

Contrast-enhanced ultrasound: may typically show a lesion heterogeneously hypervascular in the arterial phase with early washout in the delayed phase.

CT: is frequently used to both diagnose and stage renal cell carcinomas.

MRI: is excellent at imaging the kidneys and locally staging tumours

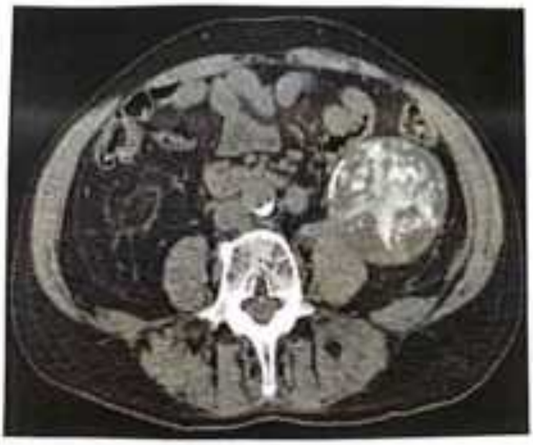
- T1: often heterogeneous due to necrosis, haemorrhage and solid components
- T2: appearances depend on histology clear cell RCC: hyperintense papillary RCC: hypointense
- T1 C+ (Gd): often shows prompt arterial enhancement

Treatment:

1. Radical nephrectomy
2. Adrenal sparing nephrectomy to partial nephrectomy
3. Percutaneous radiofrequency or cryoablation

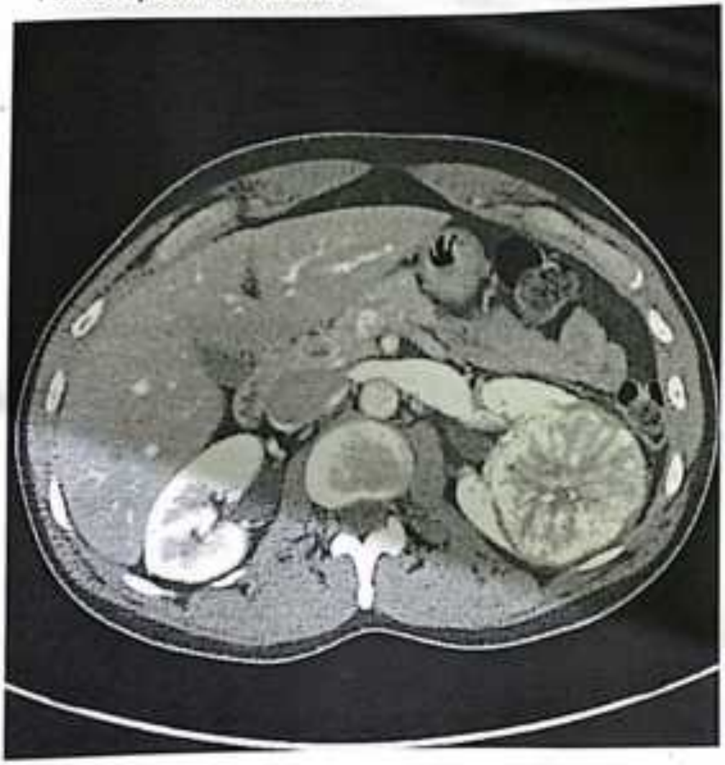
Differential Diagnosis:

1. Renal adenoma: should be considered small, early renal cell carcinomas
2. Renal oncocytoma: particularly for chromophobe type
3. Angiomyolipoma (aml)
4. Renal metastasis
5. Renal lymphoma
6. Renal abscess/pyelonephritis/lobar nephronia
7. Renal infarct



8. Hypertrophied column of bertin

9. Transitional cell carcinoma of the renal pelvis
10. Adrenal tumours
11. Retroperitoneal tumours



Intravenous pyelogram:

- Oncocytomas appear as sharply demarcated, often large exophytic masses with enhancement during the nephrographic phase.

Ultrasound:

- Ultrasound demonstrates a well-circumscribed mass with echogenicity similar to the rest of the kidney. Occasionally a central scar may be visible 9.

CT:

Tend to be large well-demarcated tumours at presentation.

Non-contrast

- If less than 3 cm - homogenous attenuation
- If more than 3 cm - heterogeneous attenuation
- Perinephric fat stranding may be present due to oedema

- Calcification may be present

Post contrast

- Small tumours may enhance homogeneously, but usually enhancement is heterogeneous and the mass is larger
- Central stellate non-enhancing scar is seen in approximately a third of cases
- Renal vein thrombosis may be present, but tumour thrombus is absent

MRI:

T1: hypointense compared to renal cortex 14

T2

- hyperintense compared to renal cortex
- may demonstrate hypointense central stellate scar

T1 C+ (Gd): usually demonstrates homogeneous enhancement

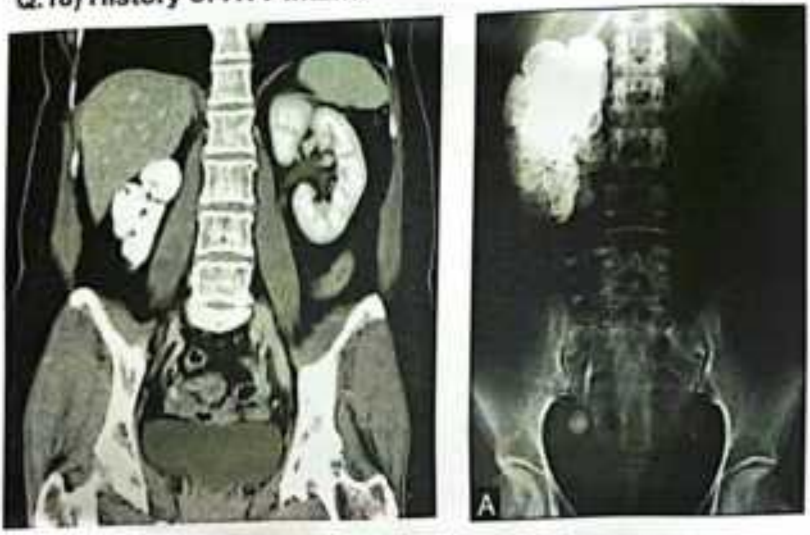
Angiography:

- May demonstrate a spoke wheel pattern, of peripheral circumferential vessels penetrating towards the centre of the lesion, which again, although characteristic of oncocytomas, may also be seen in renal cell carcinomas.

Differential diagnosis:

1. Renal cell carcinoma (RCC)
2. The imaging appearances of rccs and oncocytomas overlap to such a degree that confident pre-operative distinction is not possible
3. Metanephric neoplasms
4. Metanephric adenoma
5. Metanephric adenofibroma
6. Renal leiomyoma

Q.18) History of ATT intake **(2015)**



Identify: Plain Radiograph KUB Frontal Projection & Enhanced CT (Renal Parenchymal Phase) Coronal image Sections of Abdomen & Pelvis

Describe: Shrunken right kidney with extensive amorphous calcification and lobular margins

Diagnosis: This case demonstrates end stage renal tuberculosis (also known as TB auto nephrectomy) resulting in the so-called Putty kidney.

What next: Multi-drug treatment, Nephrectomy, partial nephrectomy or cavernostomy can be performed both open and endoscopically

Fluoroscopy

- parenchymal scars 50%
- moth eaten calyces: early finding
- irregular caliectasis
- phantom calyx
- hydronephrosis

Lower urinary tract signs

- Kerr kink
- sawtooth ureter
- pipe-stem ureter
- beaded or corkscrew ureter
- thimble bladder

Ultrasound

Early

- normal kidney or small focal cortical lesions with poorly defined border
- +/- calcification

Progressive

- papillary destruction with echogenic masses near calyces
- distorted renal parenchyma
- irregular hypoechoic masses connecting to collecting system; no renal pelvic dilatation
- mucosal thickening +/- ureteric and bladder involvement
- small, fibrotic thick-walled bladder
- echogenic foci or calcification (granulomas) in bladder wall near ureteric orifice
- localised or generalised pyonephrosis

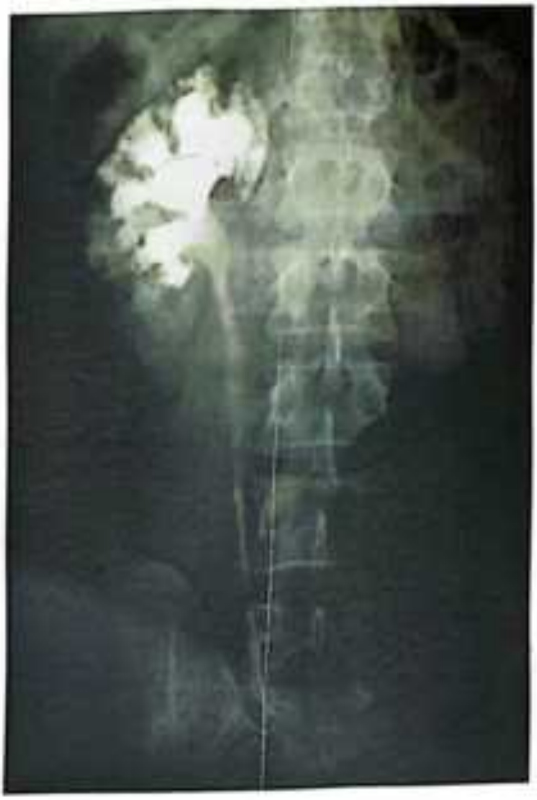
End-stage

- small, shrunken kidney, "paper-thin" cortex and dense dystrophic calcification in collecting system
- may resemble chronic renal disease

Differential Diagnosis:

- papillary necrosis
- medullary sponge kidney
- TCC (transitional cell carcinoma) of renal tract
- SCC (squamous cell carcinoma) of renal tract
- xanthogranulomatous pyelonephritis (XGP)

Q.19) **(2014)**



40 years old male with haematuria

Identify: Intravenous urography (IVU), Intravenous pyelography (IVP), Excretory urography (EU) Prone Image

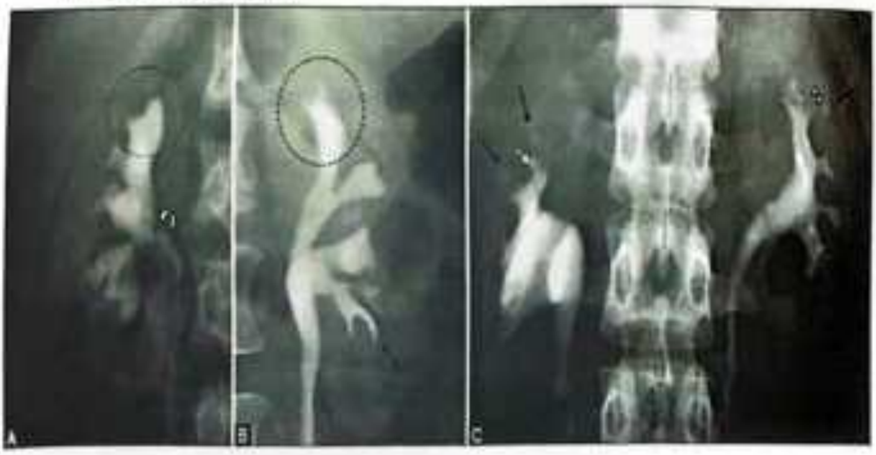
Describe: Ectatic distal collecting ducts and also dilated contrast filled intrapapillary tubules within the renal medulla are seen on intravenous pyelogram- characteristic bouquet of flowers appearance- "paintbrush" appearance

Diagnosis: Medullary sponge kidney

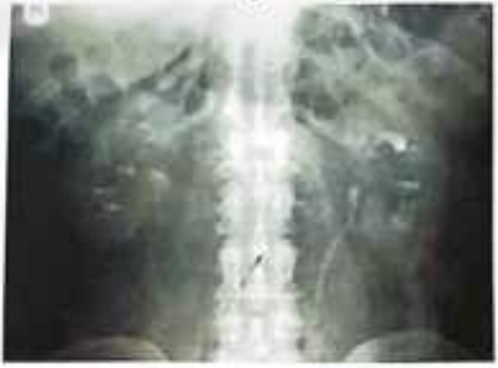
Differential Diagnosis:

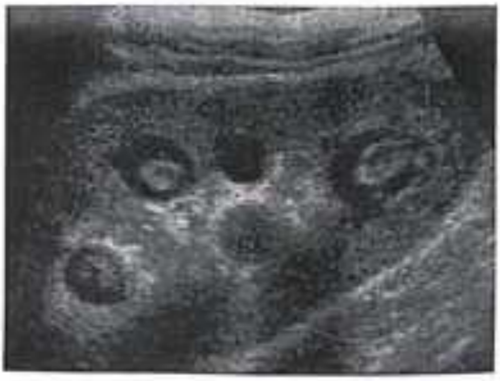
- medullary calcifications
- medullary cysts
- medullary cystic disease (nephronophthisis)
- renal tubular ectasia

Q.20) Intravenous urogram revealing papillary necrosis in the upper group of calyces, with irregularity of the calyceal margins and the lateral margin of the upper infundibulum (dotted circle), indicating spread of infection from the calyx to the infundibulum



Signs: ball on tee, forniceal excavation, lobster claw, signet ring, sloughed papilla with clubbed calyx

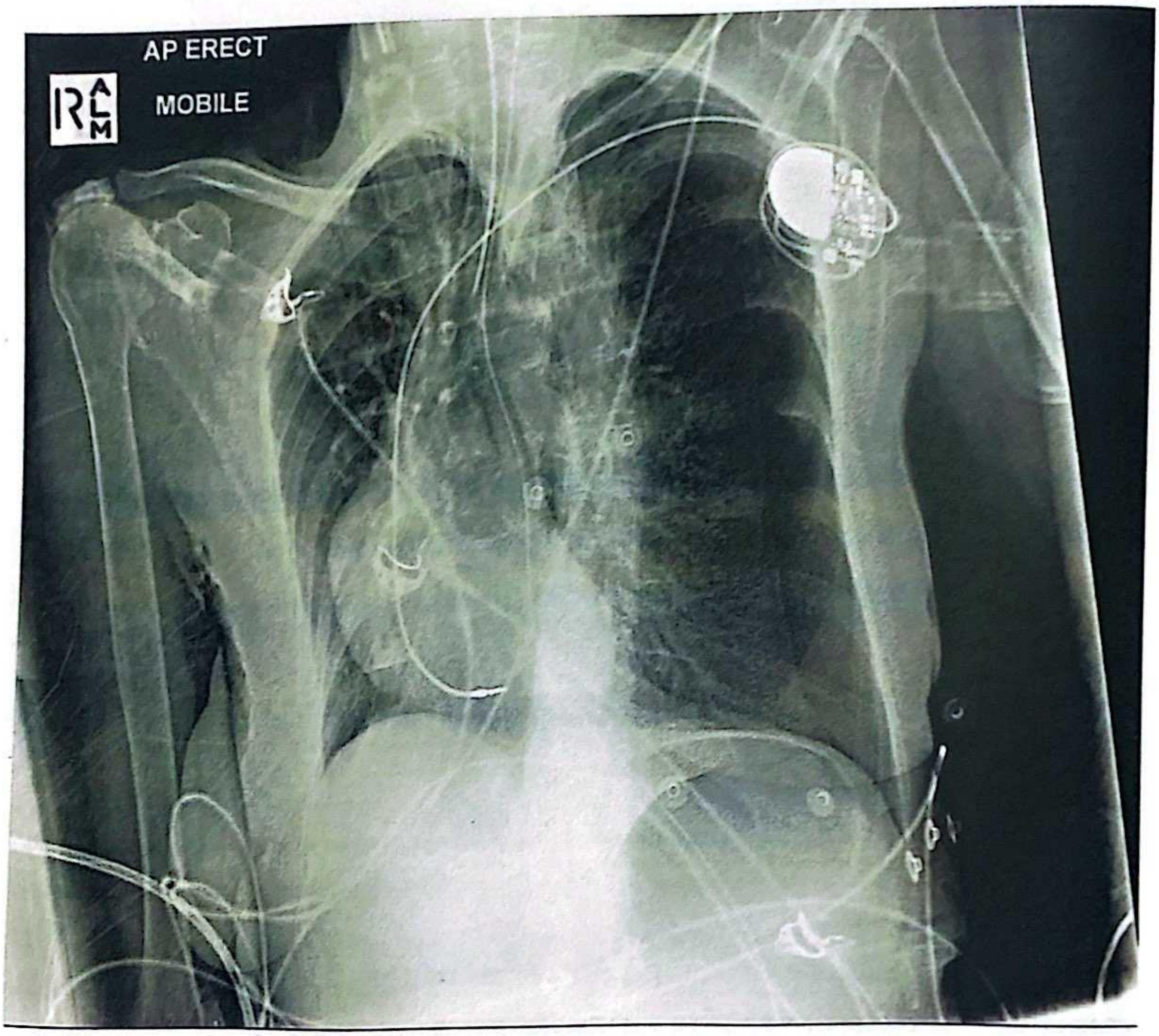




CHEST

Q.1) Code blue. Recent pacemaker insertion-AGE: 70- GENDER: Female

(2017), (2016)



Identify: Portable X-ray Chest Frontal Projection

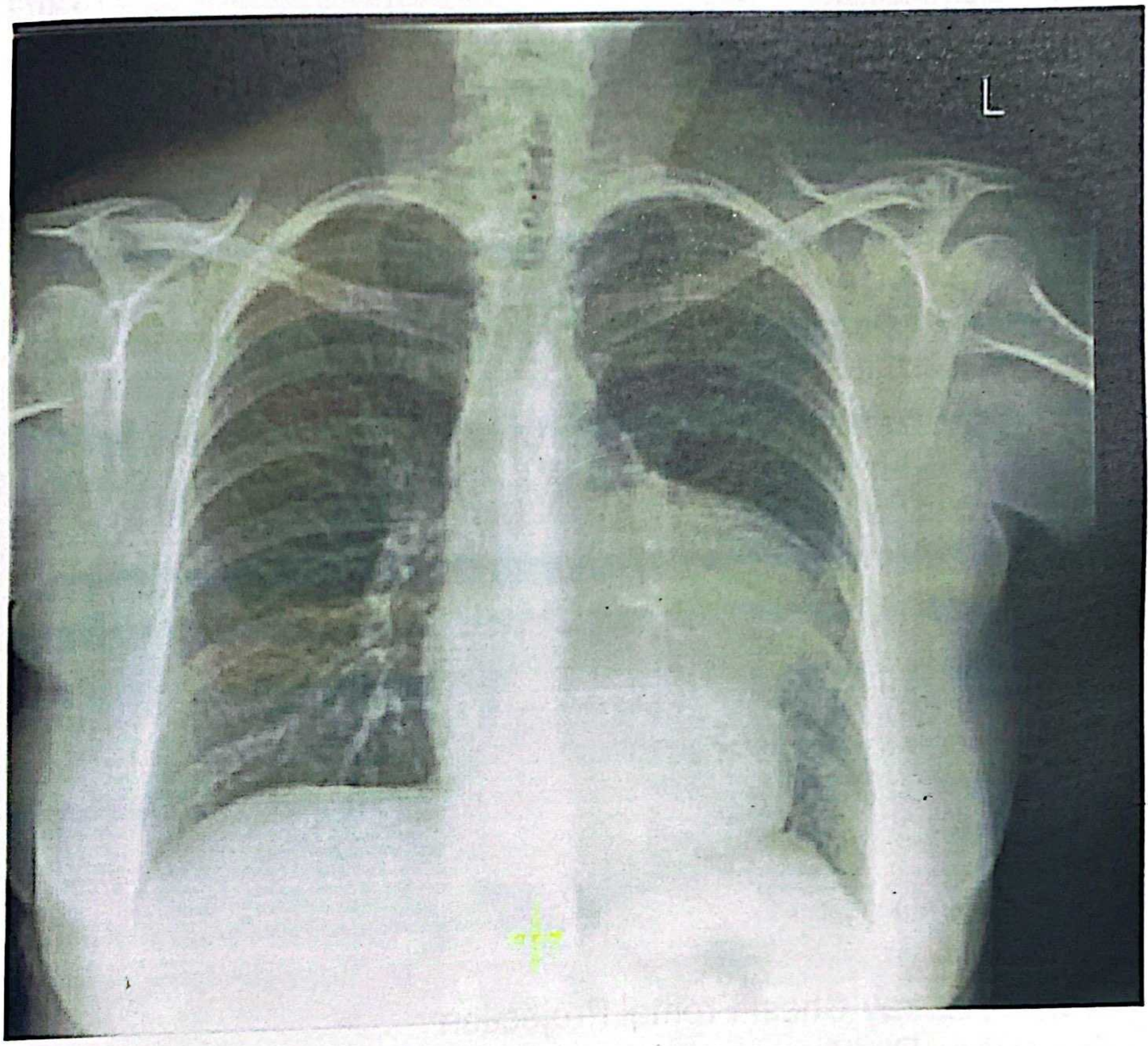
Describe: Left pneumothorax. Mediastinal shift towards right, depression of left hemidiaphragm with associated mass effect on ribs

Pacemaker, ETT, Nasogastric tubes seen

Diagnosis: Tension pneumothorax mimic due to right lower lobe hypoplasia

What next: Inform the primary physician, A chest drain should be inserted

Q.2) **(2017)**



Identify: X-ray Chest Frontal Projection

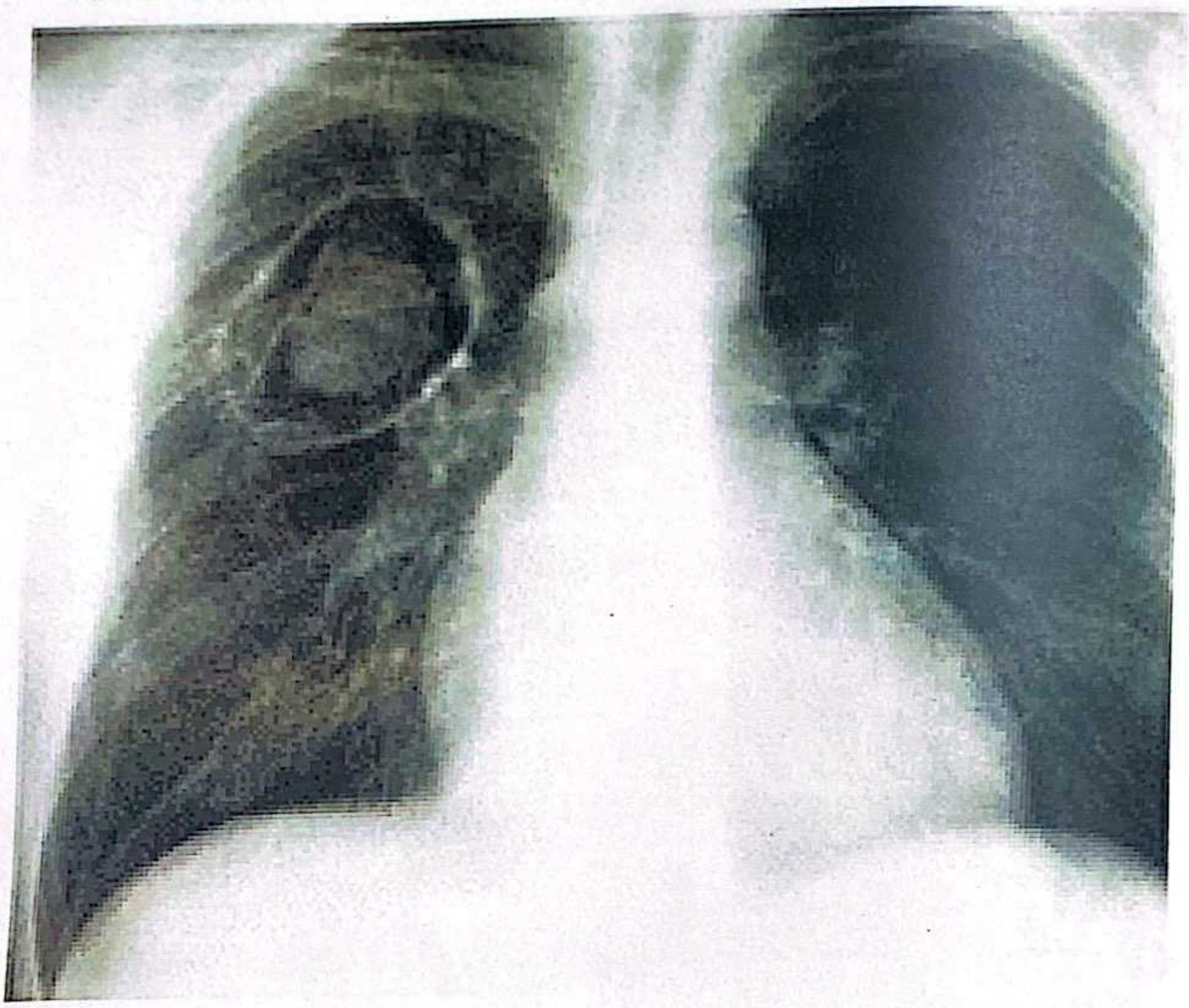
Describe: Main Pulmonary artery shows prominent dilatation, Cardiac size is enlarged with bilateral bulky hila's. No major lung collapse or consolidation seen. Broncho vascular markings are slightly increased

Diagnosis: Main pulmonary artery aneurysm

What next:

- CT angiography (CTA) allows much better appreciation of anatomy
- Contrast enhanced CT

Q.3) A 45-year-old man was admitted for relapse of acute promyelocytic leukemia nine months after the first remission (2017)



Identify: X-ray Chest Frontal Projection

Describe: Right upper lung zone shows a rounded or ovoid soft tissue attenuating masses located in a surrounding cavity and outlined by a crescent of air-Monad sign. Adjacent pleural wall thickening also noted.

Diagnosis: Aspergilloma/mycetoma (mass-like fungus ball)

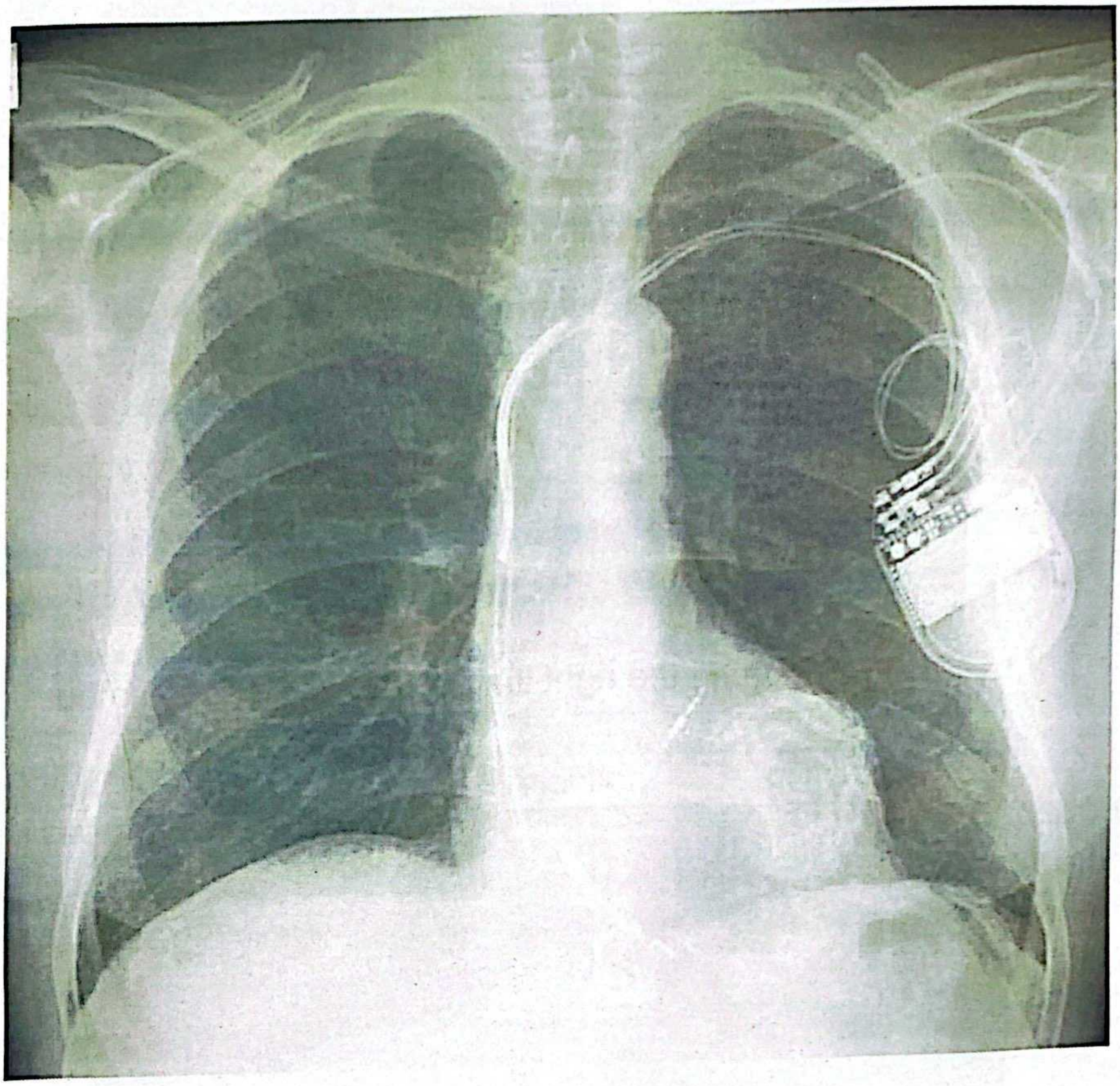
What next:

- HRCT
- Contrast enhanced CT
- Bronchial artery embolization
- Surgical excision with a lobectomy remains the gold standard

Differential Diagnosis:

- Hydatid cyst
- Rasmussen aneurysm in a tuberculous cavity
- Pulmonary abscess, Hematoma, Bronchogenic carcinoma

Q.4) **(2017)**



Identify: X-ray Chest Frontal Projection

Describe: Calcified opacity projected over the left heart border is demonstrated in keeping with a left ventricular aneurysm. Cardiac pacemaker seen in situ.

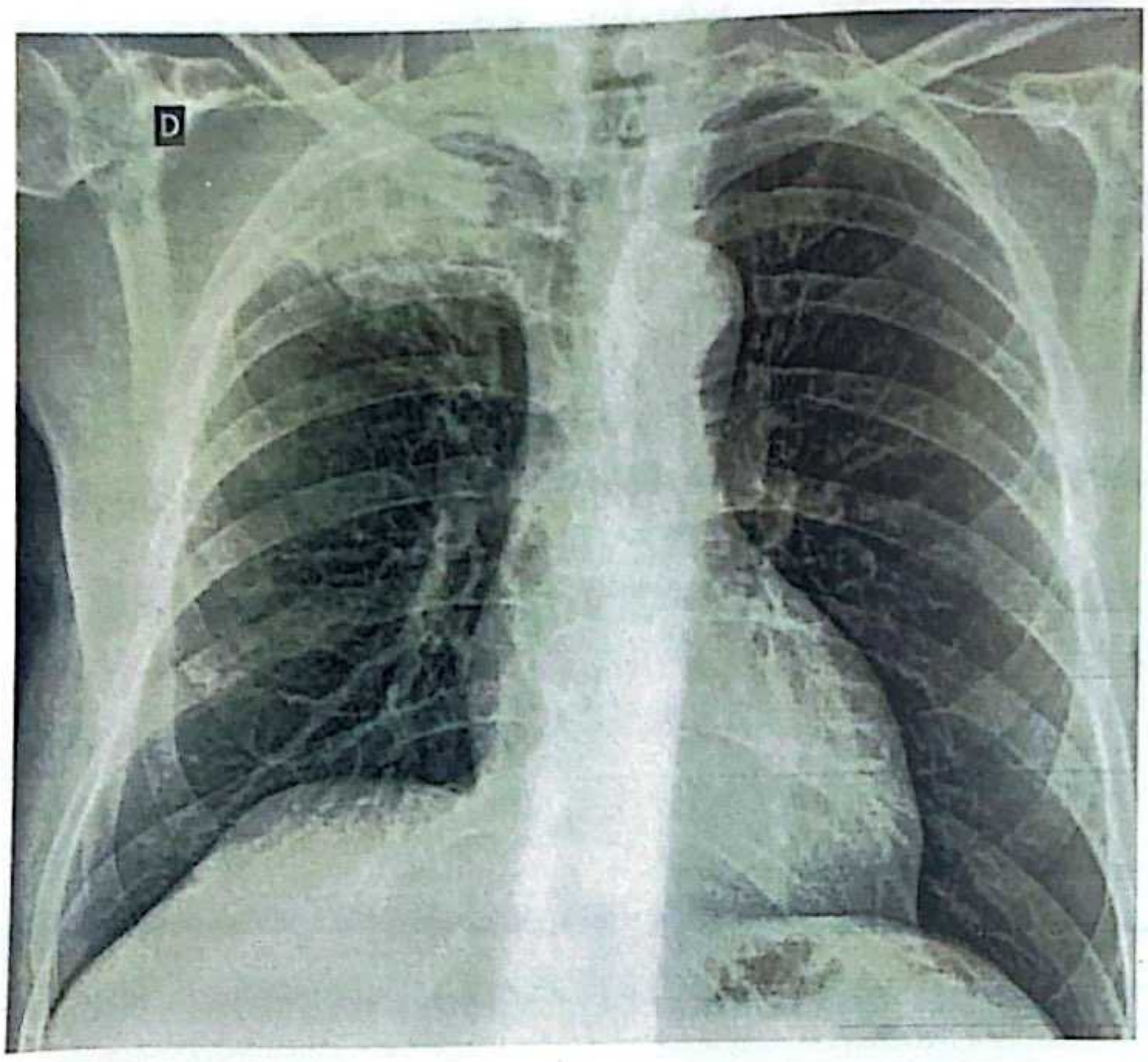
Diagnosis: Left ventricular aneurysm

What next: Echocardiography, cardiac MRI and cardiac ventriculography can detect LV aneurysms

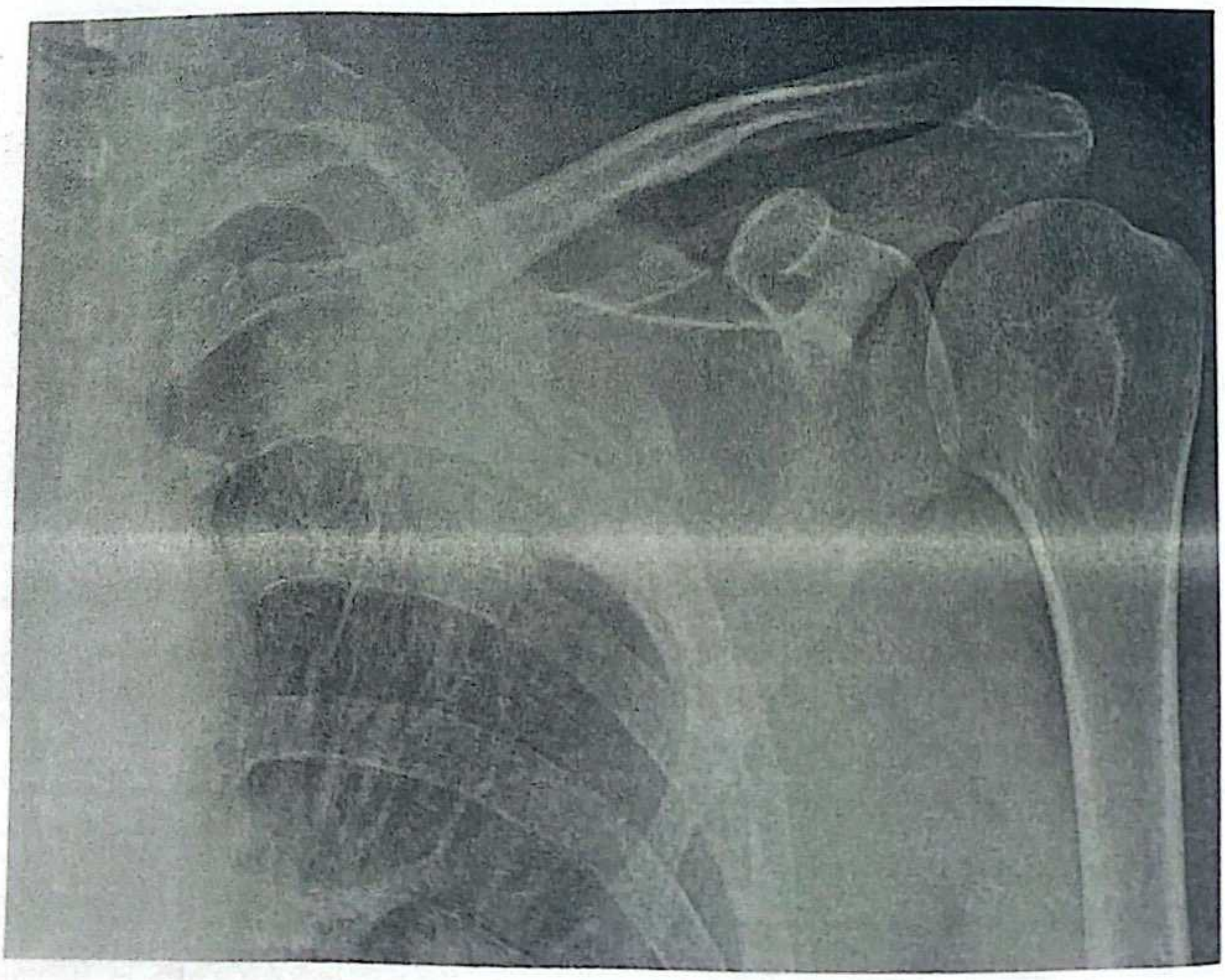
Complications:

- intramural thrombus formation
- impairment in cardiac output
- rupture of the aneurysm: rare (the rupture rate is higher with pseudoaneurysms)

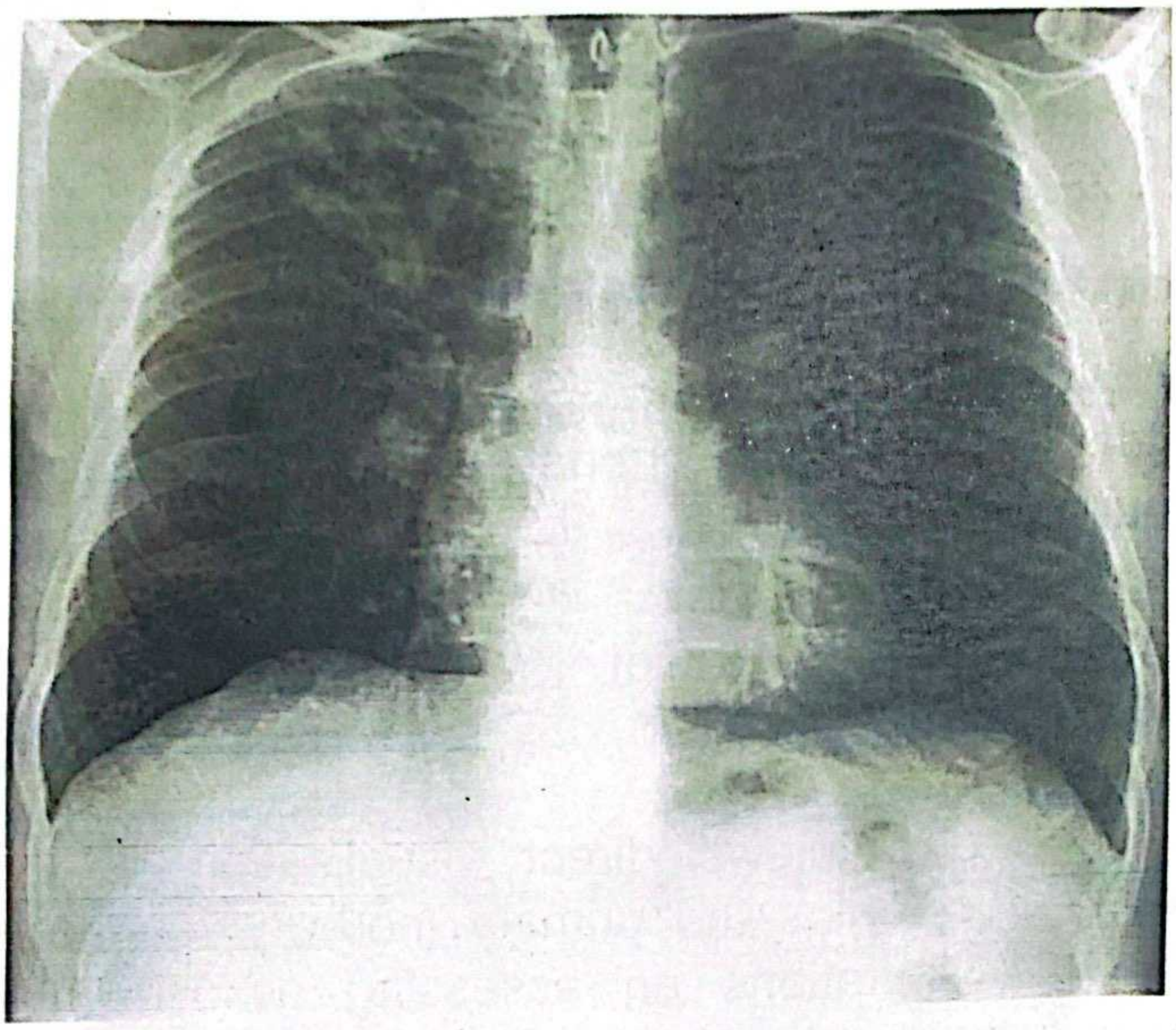
Q.5)



Opacity obscuring the right lung apex-- Pancoast tumour



Q.6) Long history of respiratory wheeze and chronic cough-35 years-Male (2016)



Identify: X-ray Chest Frontal Projection

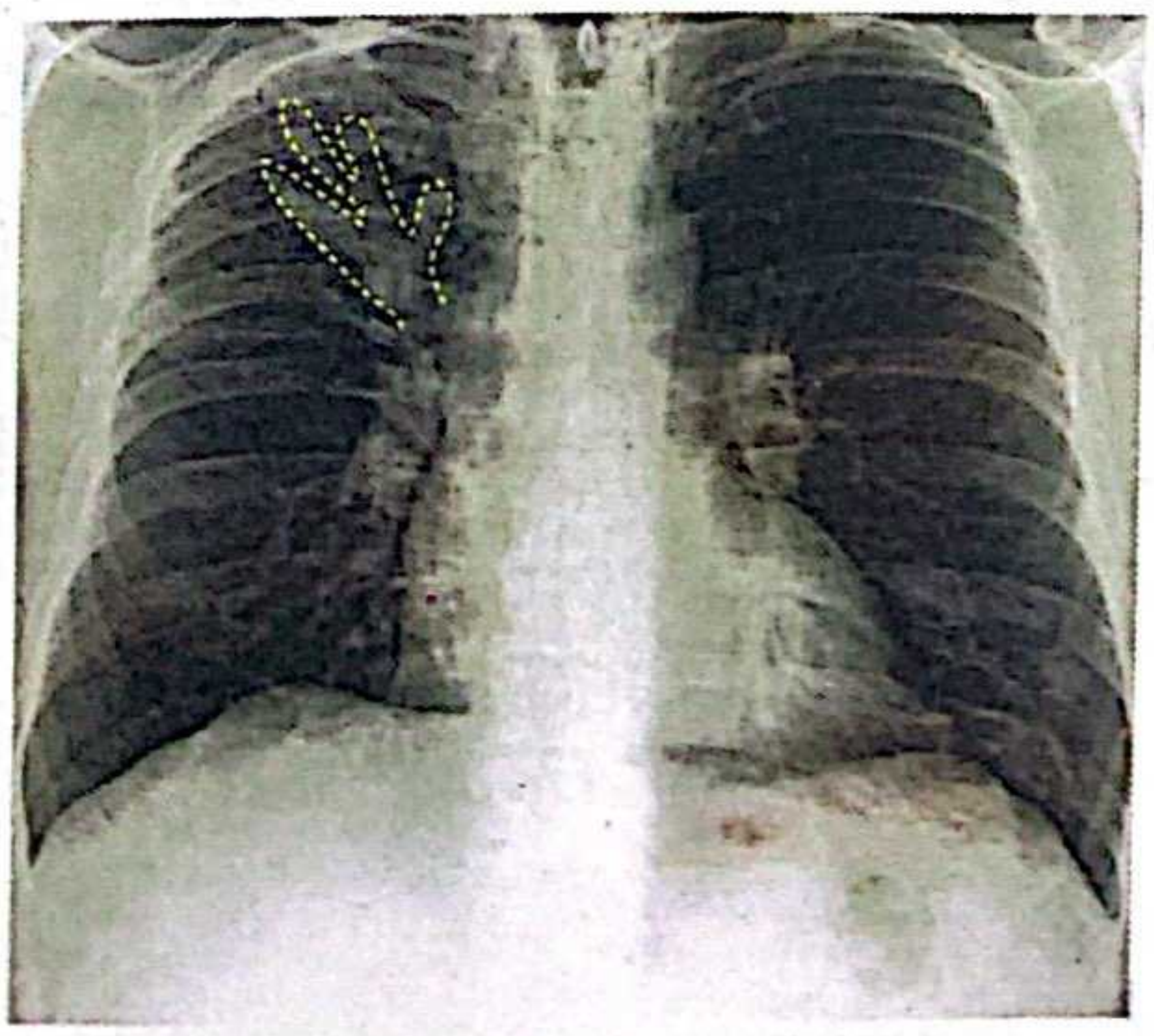
Describe: Chest x-ray demonstrates tubular mass-like or sausage shaped branching opacities in the right upper lobe giving Finger in Glove like appearance. In the left upper lobe a number parallel lines extending from the hilum (tram track).

Diagnosis: Allergic bronchopulmonary aspergillosis (ABPA) along with bronchiectasis

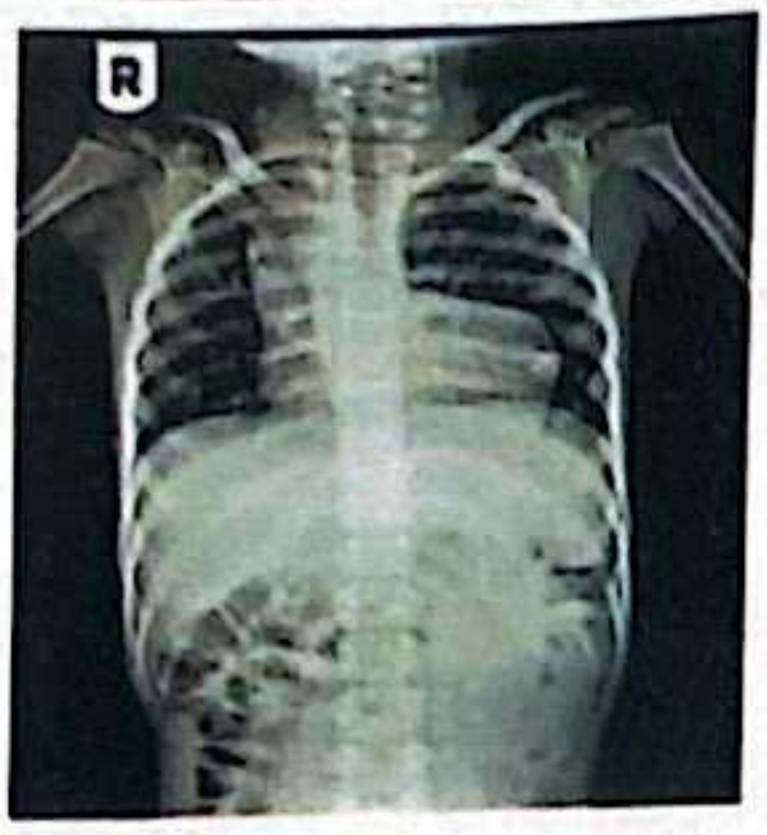
What next: CT chest with contrast

Differential Diagnosis:

- Congenital tracheobronchomegaly (Mounier Kuhn syndrome)
- Cystic fibrosis
- Williams Campbell syndrome (rare)



Q.7) **(2016)**



Identify: X-ray Chest Frontal Projection

Describe:

- boot shaped" heart
- elevated cardiac apex
- concave pulmonary arterial segment
- pulmonary oligaemia
- right sided aortic arch

Diagnosis: Tetralogy of Fallot

What next:

Echocardiography

Echocardiography allows direct visualisation of the abnormal anatomy and remains the primary modality for the diagnosis of TOF. It has limitations on assessing associated extracardiac anomalies (e.g. peripheral pulmonary stenosis and atresia).

CT/CTA

MDCT is useful in demonstrating the complex cardiovascular morphology of TOF, especially the anatomy of the pulmonary and coronary arteries as well as identification of aortopulmonary collateral vessels (MAPCAs). MDCT can be used to evaluate post-surgical changes (e.g. patency of palliative shunts) and complications.

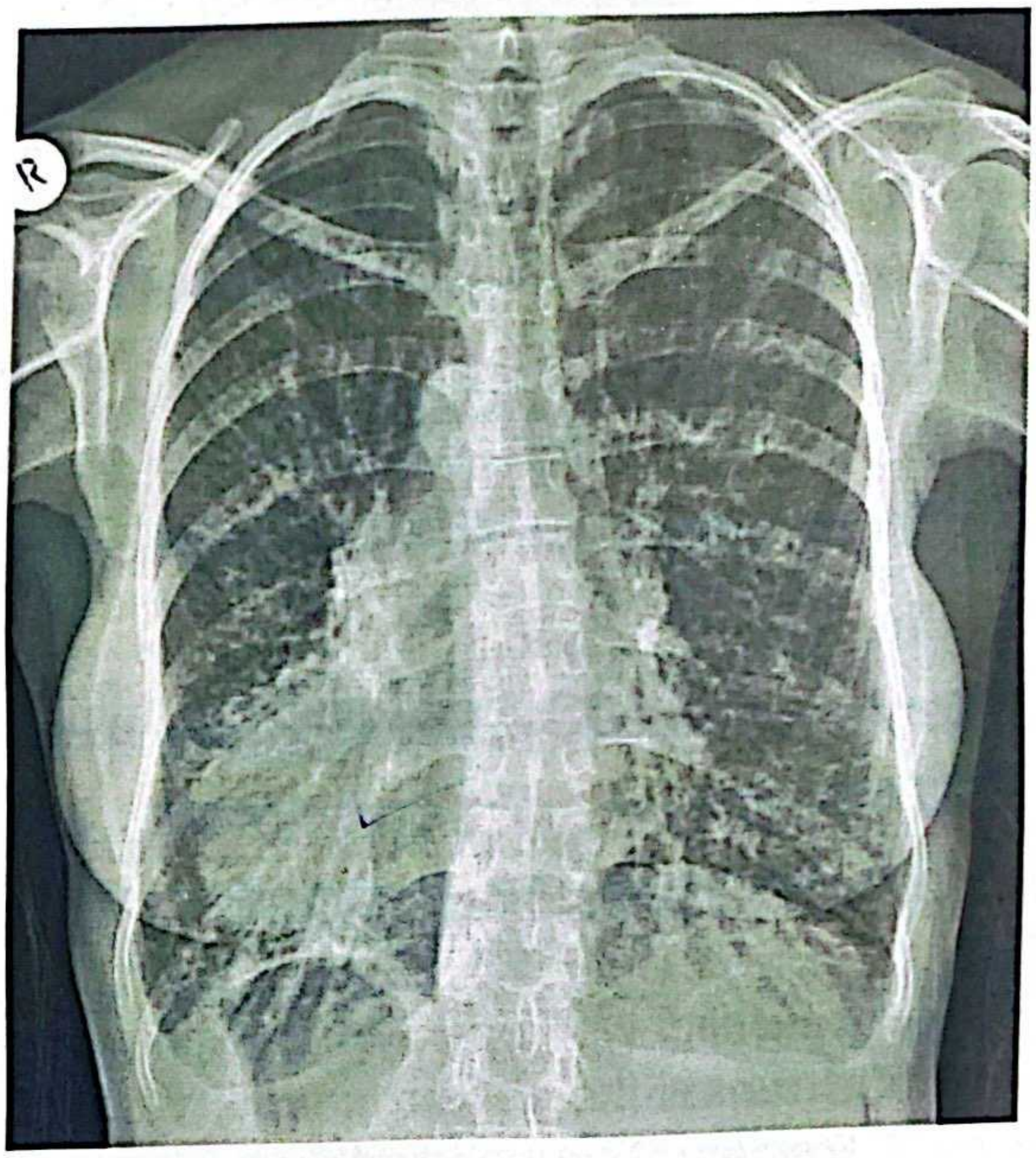
MRI

MRI has the great advantage of providing both exquisite anatomical details and functional information without ionising radiation. The detailed assessment of the pulmonary artery is of importance because repair of the cardiac defects without addressing pulmonary artery hypoplasia/stenosis has a poor outcome.

Treatment and prognosis

- shunts: designed to reduce cyanosis
- Pott shunt
- Waterston shunt
- Blalock-Taussig shunt: still performed in selected cases
- Primary repair is now the preferred treatment and is usually performed at the time of diagnosis.

Q.8) Cough in patient with known history of chronic lung disease-40 years-Female (2016), (2018)



Identify: X-ray Chest Frontal Projection

Describe: Chest x-ray demonstrates dextrocardia, hyperinflation of the lungs alongwith bronchial wall thickening, bronchial dilatation with the loss of normal peripheral tapering and extensive linear tram-track opacities suggestive of bronchiectasis. Stomach bubble is on right side consistent with situs inversus

Diagnosis: Kartagener syndrome

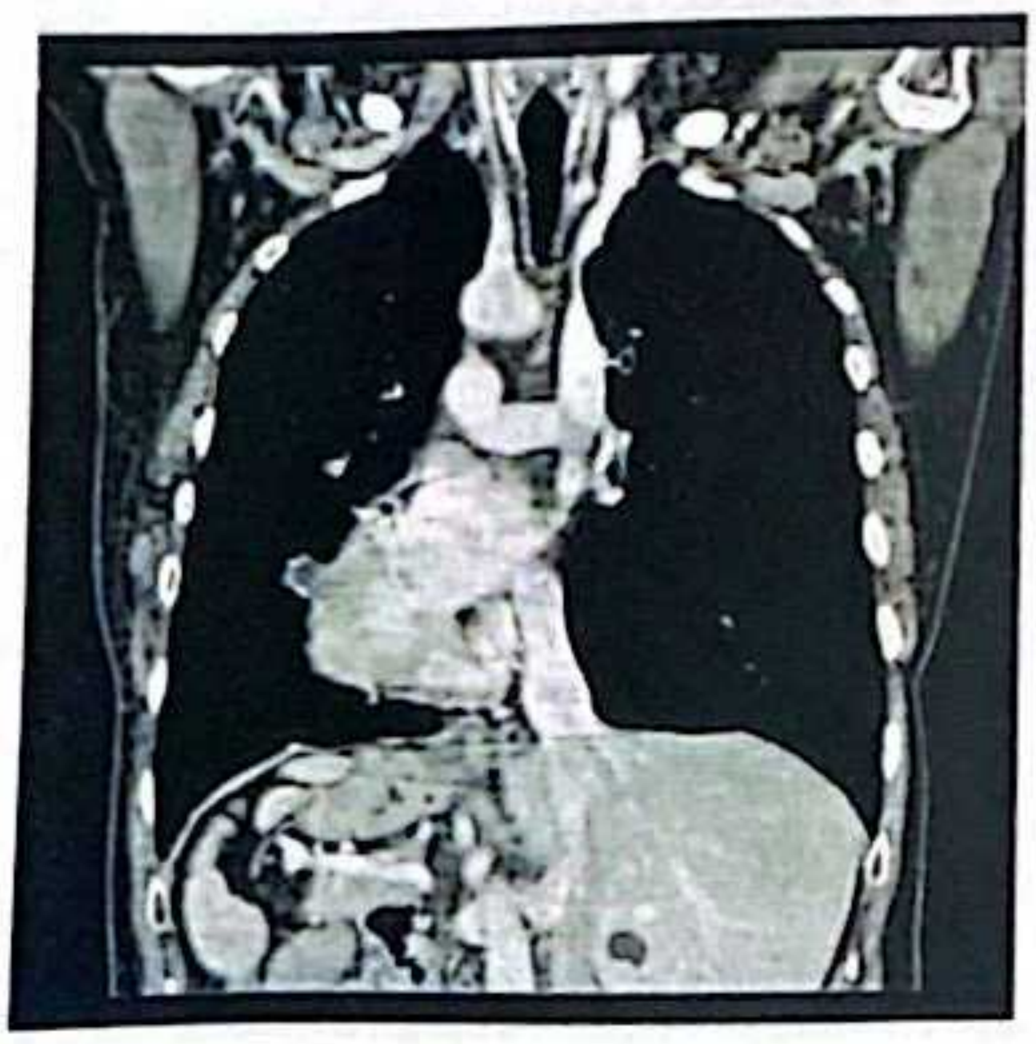
What next:

- HRCT
- Contrast Enhanced CT Chest
- Infertility workup- Seminal fluid analysis
- Counsel patient
- Counsel the patient

Differential Diagnosis:

- cystic fibrosis
- Young syndrome
- acquired immunodeficiency (AIDS)
- ABPA
- graft versus host disease

Q.9) Cough in patient with known history of chronic lung disease-40 years-Female (2016)



Identify: CT Chest coronal mediastinal window

Describe: CT demonstrates dextrocardia, hyperinflation of the lungs.

Stomach bubble is on right side consistent with situs inversus

Diagnosis: Kartagener syndrome

What next:

- Infertility workup- Seminal fluid analysis
- Counsel the patient
- Review CT lung window

CT

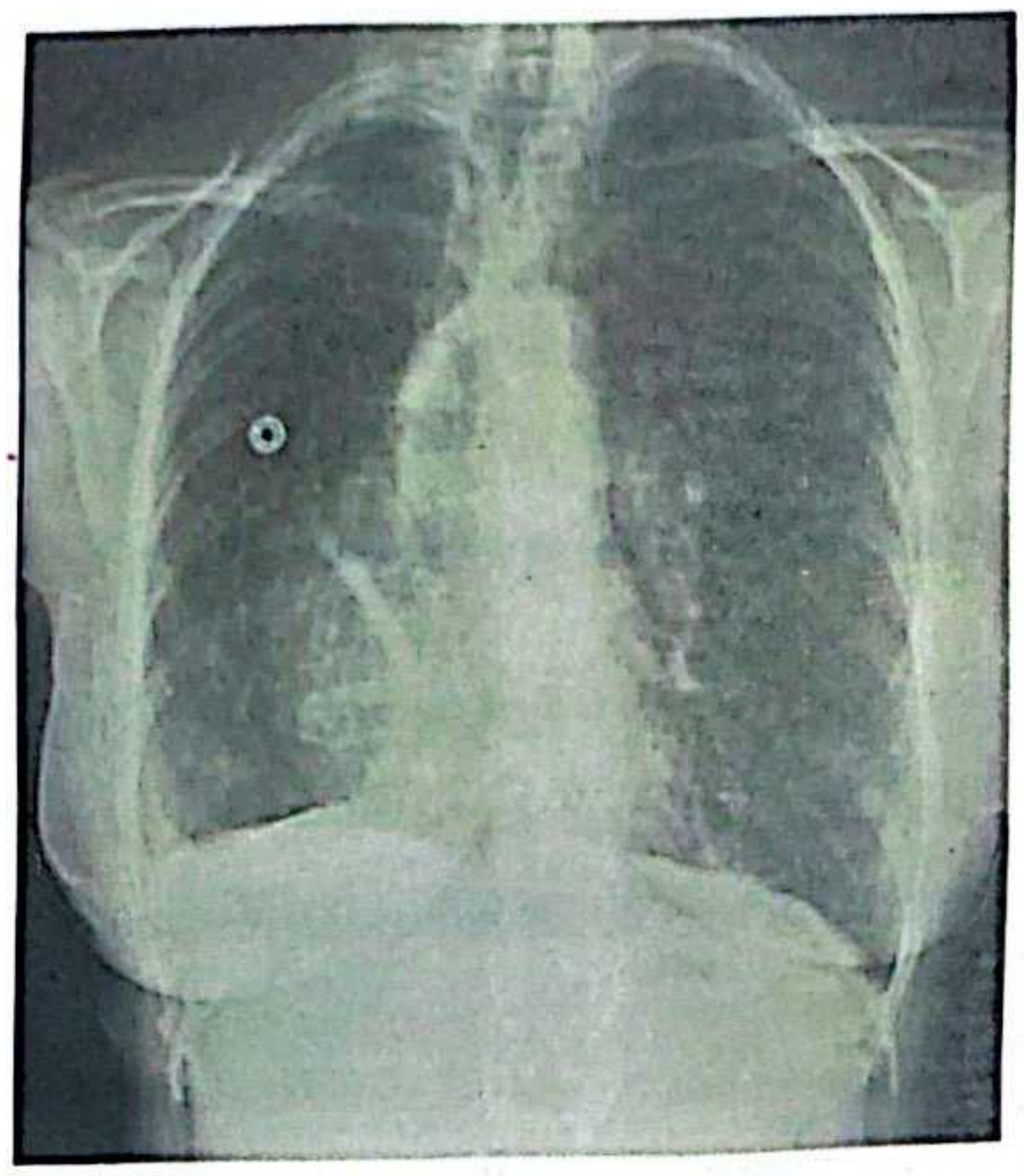
CT tends to demonstrate bronchiectasis which may be variable in severity. However, changes are much milder than in cystic fibrosis. The morphology of bronchiectasis can be tubular/cylindrical or saccular/cystic. Also, CT demonstrates:

- consolidation
- mucocoele, impacted mucus in bronchioles
- tree-in-bud pattern or centrilobular nodules may be encountered with mucus impaction and endobronchial spread of infection
- mosaic perfusion/air trapping as ancillary findings
- eventual scarring may result from recurrent infection, requiring pulmonary resection surgery

Differential Diagnosis:

- cystic fibrosis
- Young syndrome
- acquired immunodeficiency (AIDS)
- ABPA
- graft versus host disease

Q.10) Chest pain and cough-60Y-Female (2017)



Identify: X-ray Chest Frontal Projection

Describe: The right hemithorax is hypoplastic. Also, a tubular structure is seen in the lower right lung, which has the shape of a scimitar; The heart is displaced to the right. The left pulmonary artery is very prominent.

Diagnosis: The findings are suggestive of Scimitar's syndrome (pulmonary venolobar syndrome or hypo genetic lung syndrome), a type of partial anomalous pulmonary venous return (PAPVR).

What next:

- Transthoracic or transesophageal echocardiography
- Angiography
- CT Angiography
- MR angiography.

Treatment and prognosis

- Surgical correction should be considered in the presence of significant left to right shunting and pulmonary hypertension.

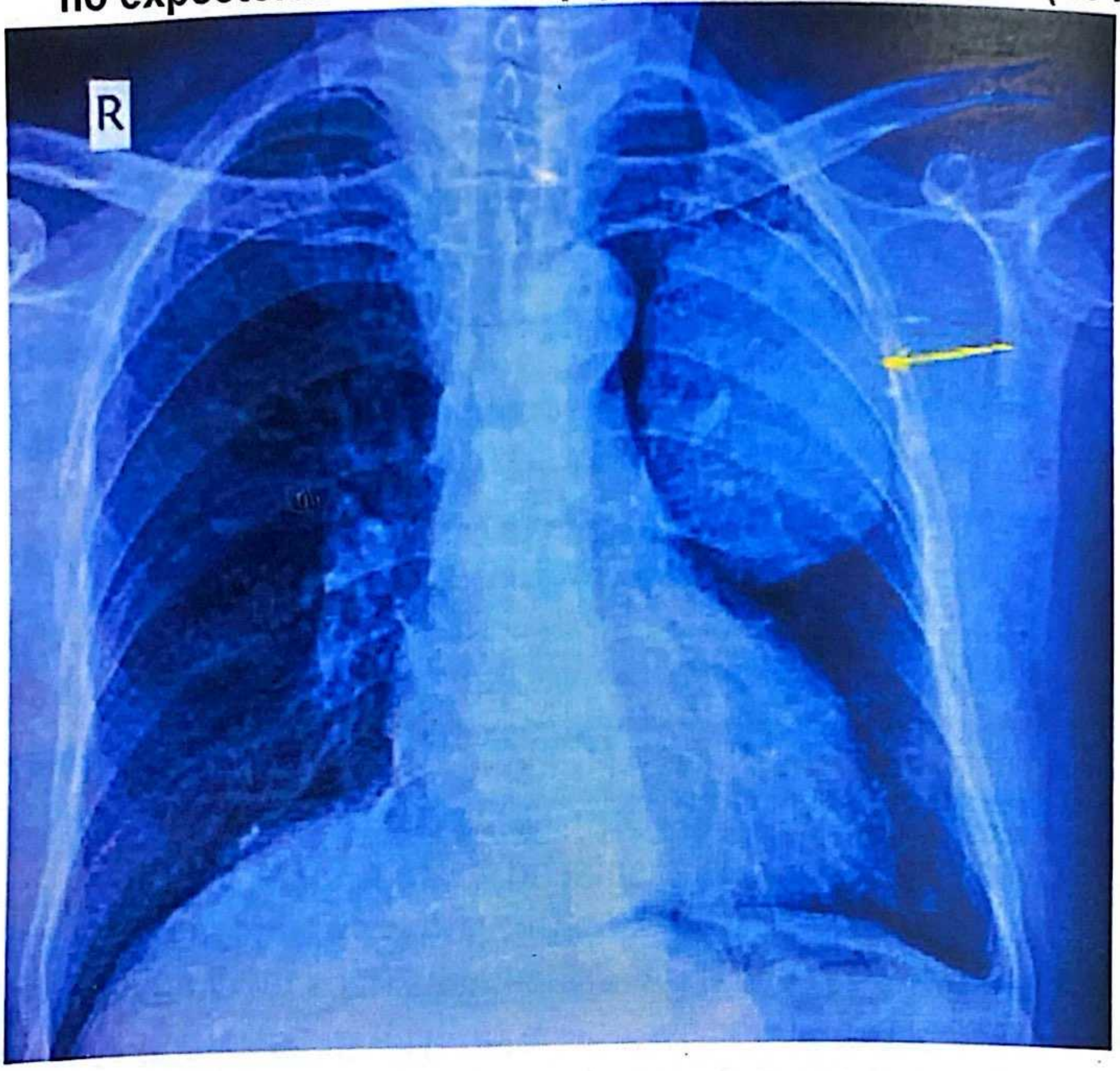
Complications

- The presence of a left-to-right shunt may lead to a development of pulmonary hypertension and Eisenmenger physiology.

Differential Diagnosis:

- pulmonary sequestration
- right middle lobe atelectasis (on AP plain radiograph)
- unilateral absence of pulmonary artery (UAPA)

Q.11) Chief complaint of breathlessness with cough and fever, no expectoration or hemoptysis. (2017)



Identify: X-ray Chest Frontal Projection

Describe: A well-defined homogeneous opacity seen in left upper lung field not silhouetting the cardiac borders

Diagnosis: Hydatid cyst

What next:

- Contrast enhanced CT chest
- Casoni skin test

A particularly helpful mnemonic for causes of pulmonary cavities is:

CAVITY

Mnemonic

C: cancer

bronchogenic carcinoma: most frequently squamous cell carcinoma (SCC)

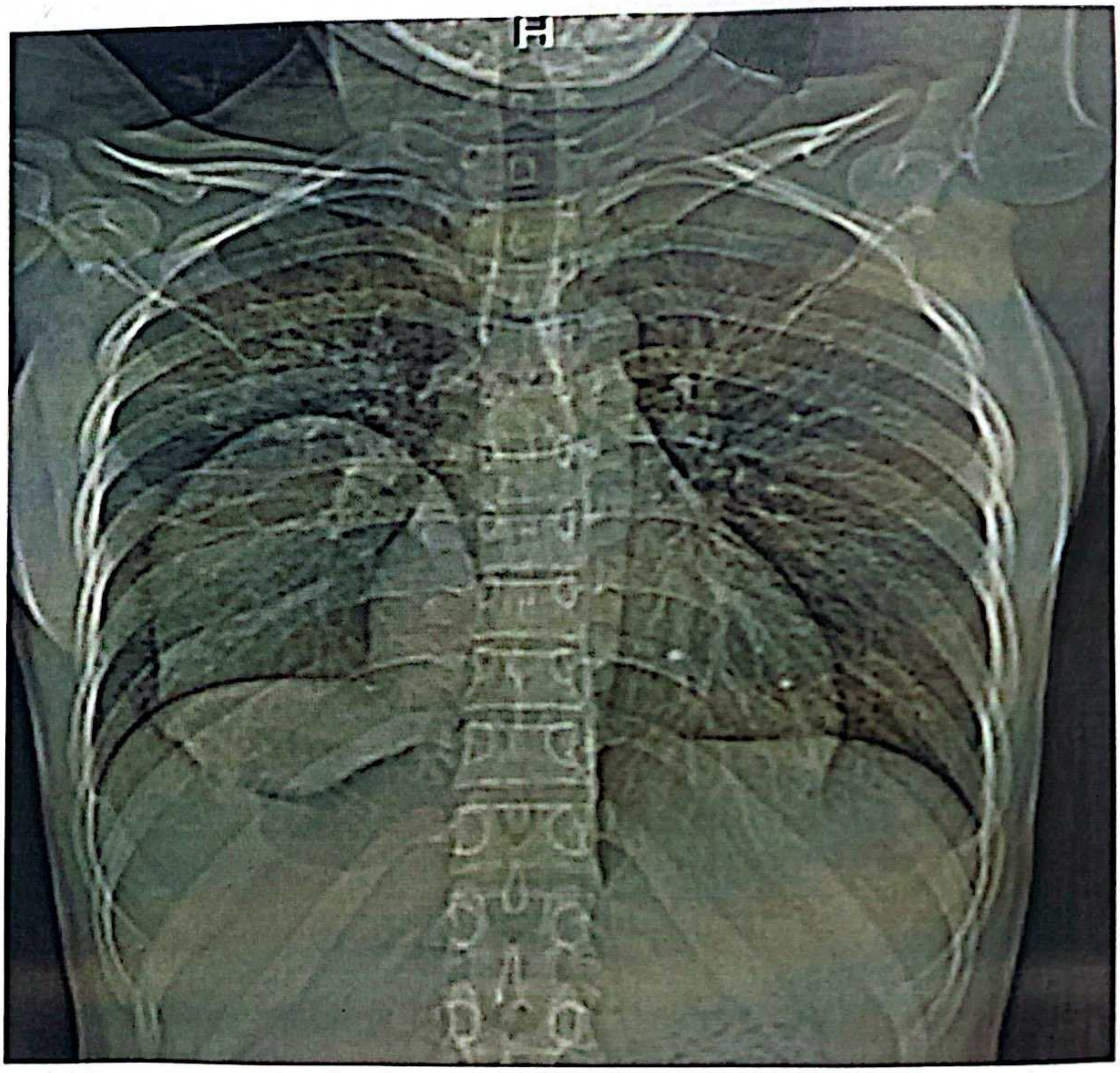
cavitary pulmonary metastasis(es): most frequently SCC

A: autoimmune; granulomas from

Wegener granulomatosis (granulomatosis with polyangiitis)

rheumatoid arthritis (rheumatoid nodules) etc

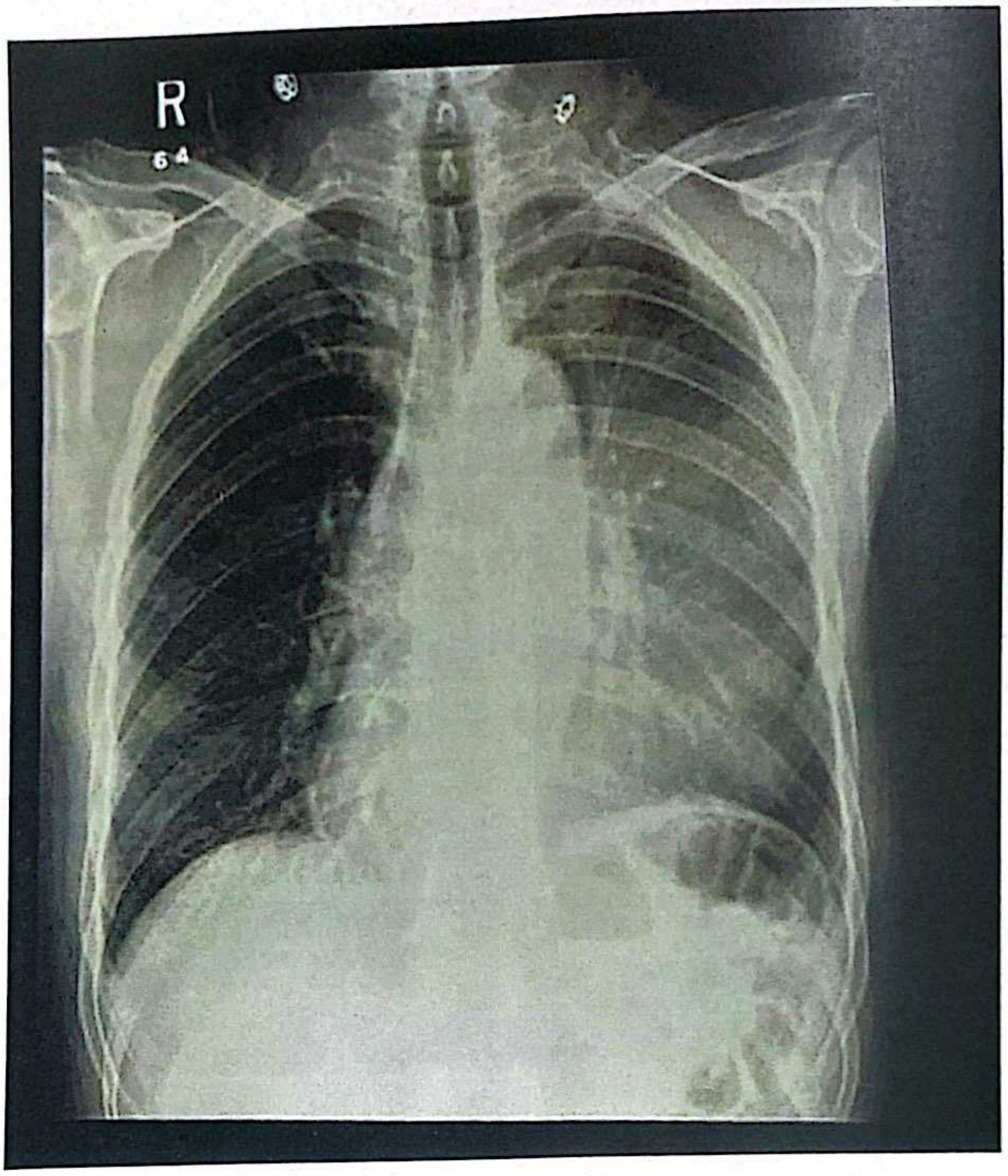
V: vascular (both bland and septic pulmonary emboli)
I: infection (bacterial/fungal)
pulmonary abscess
pulmonary tuberculosis
T: trauma - pneumatoceles
Y: youth
CPAM (congenital pulmonary airway malformation)
pulmonary sequestration
bronchogenic cyst



A well-defined homogenous cavitatory lesion in right lower lung. Simillar lesion is seen in the liver

Hydatid cysts in lung and liver both

Q.12) Shortness of breath-50y-Female (2016)



Identify:
X-ray Chest Frontal Projection

Describe: Hazy or veiling opacity extending out from the hilum and fading out inferiorly.

Parts of the cardiomediastinal contour may be obliterated. Lucency medially around aortic arch-luftsichel sign.

Left hilum drawn upwards.

Elevation of the hemidiaphragm 'peaked' or 'tented' hemidiaphragm: juxtaphrenic peak sign

Crowding of the left sided ribs

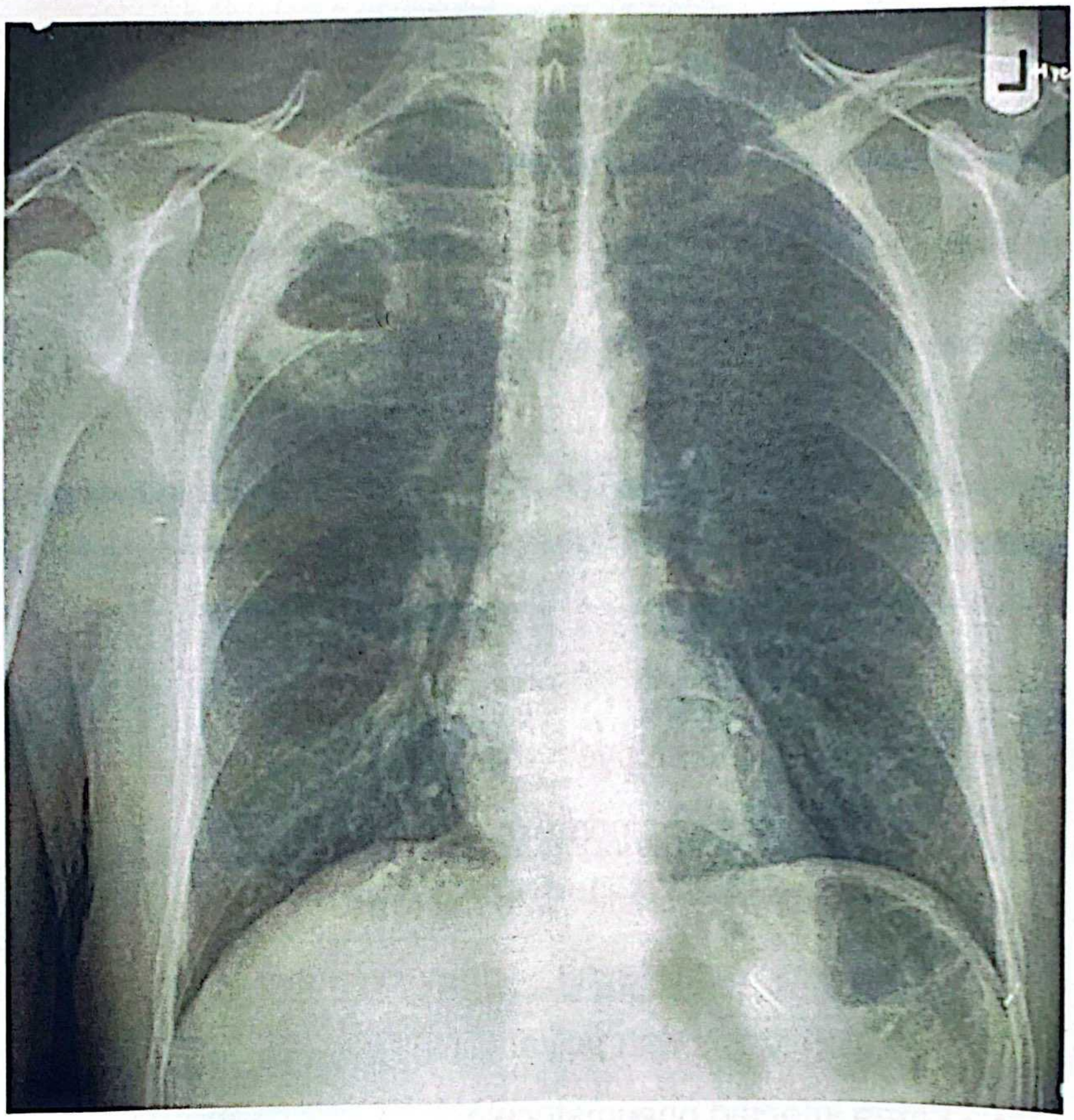
Shift of the mediastinum to the left

Diagnosis: Left upper lobe collapse

What next:

- CT chest with IV contrast to exclude mass/ endobronchial lesion.
- Bronchoscopy +/- biopsy.

Q.13) Presented to emergency department with fever and cough-44Y-Male (2015)



Identify: X-ray Chest Frontal Projection

Describe: Thick walled right upper lobe cavitary lung lesion with air fluid level. Thickening of surrounding parenchyma also seen. Slightly increased Broncho vascular markings.

Diagnosis: Lung abscess

What next:

- Contrast enhanced CT chest
- Ultrasound

- Bronchoscopy may be beneficial in establishing bronchial patency to improve drainage

Treatment

- Lung abscesses are usually managed with prolonged antibiotics and physiotherapy with postural drainage
- Percutaneous drainage under CT guidance

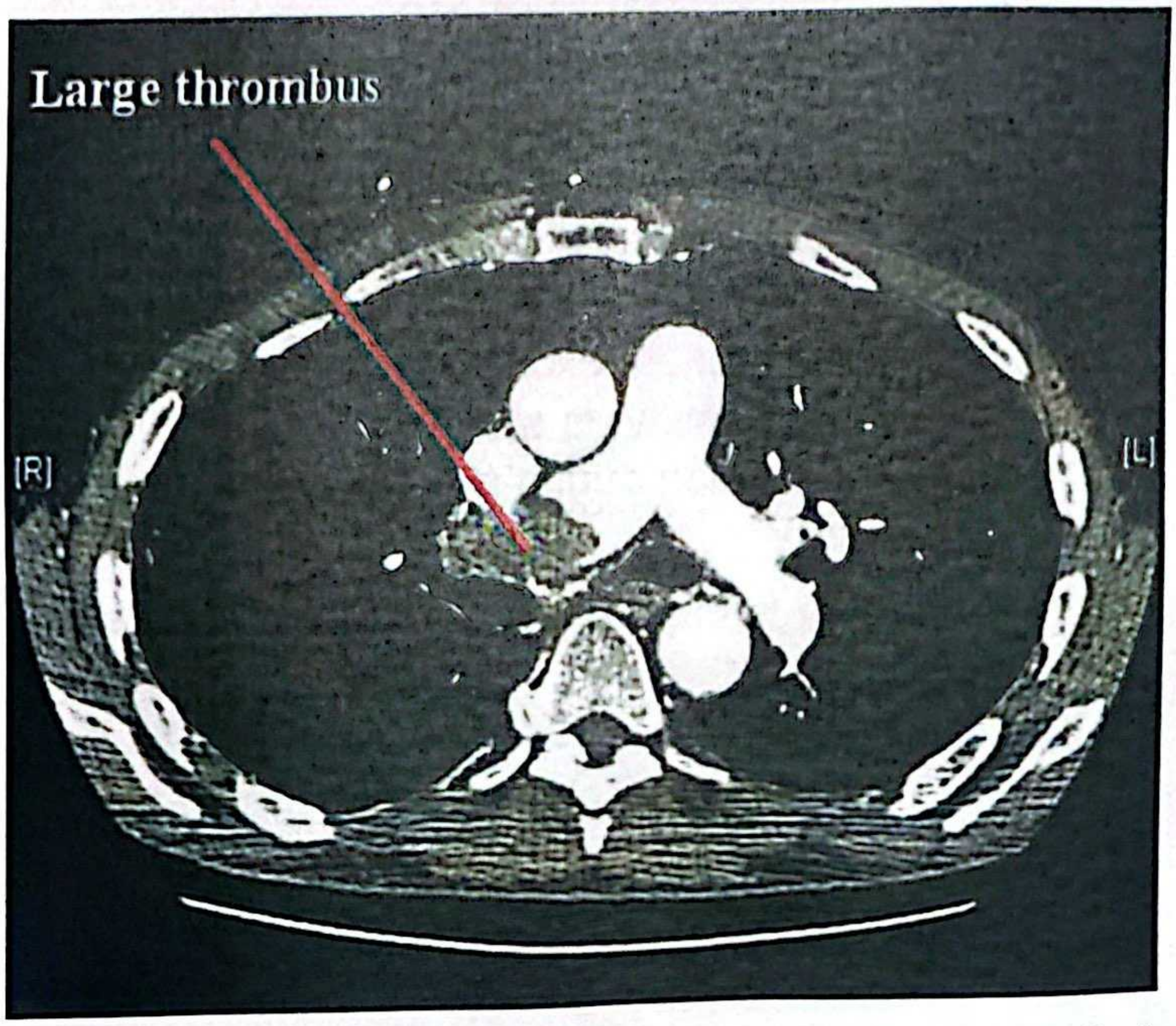
Complications

- Empyema
- Bronchopleural fistula
- Haemorrhage (from chest wall or the lung)
- Klebsiella pneumoniae

Differential diagnosis

- Empyema (see empyema vs pulmonary abscess)
- Bronchogenic carcinoma (cavitating)
- Pulmonary metastasis: with necrosis
- Pulmonary cavitating granulomatous disease (e.g. granulomatosis with polyangiitis)
- Large infected pneumatocele
- Infected emphysematous bulla
- Cavitating pneumonia
- Necrotising pneumonia
- Pulmonary tuberculosis
- Hiatus hernia (especially for a retrocardiac abscess)

Q.14) Shortness of breath (2015)



Identify: Contrast enhanced CT chest Mediastinal Window Axial Section

Describe: Large Filling defect seen in the pulmonary artery

Diagnosis: Pulmonary artery thrombus

What next:

- X-ray chest to rule out any parenchymal abnormality
- CT pulmonary angiography (CTPA)
- Ventilation/perfusion (V/Q) scan
- D-dimer (ELISA)
- Magnetic resonance pulmonary angiography

Treatment and prognosis

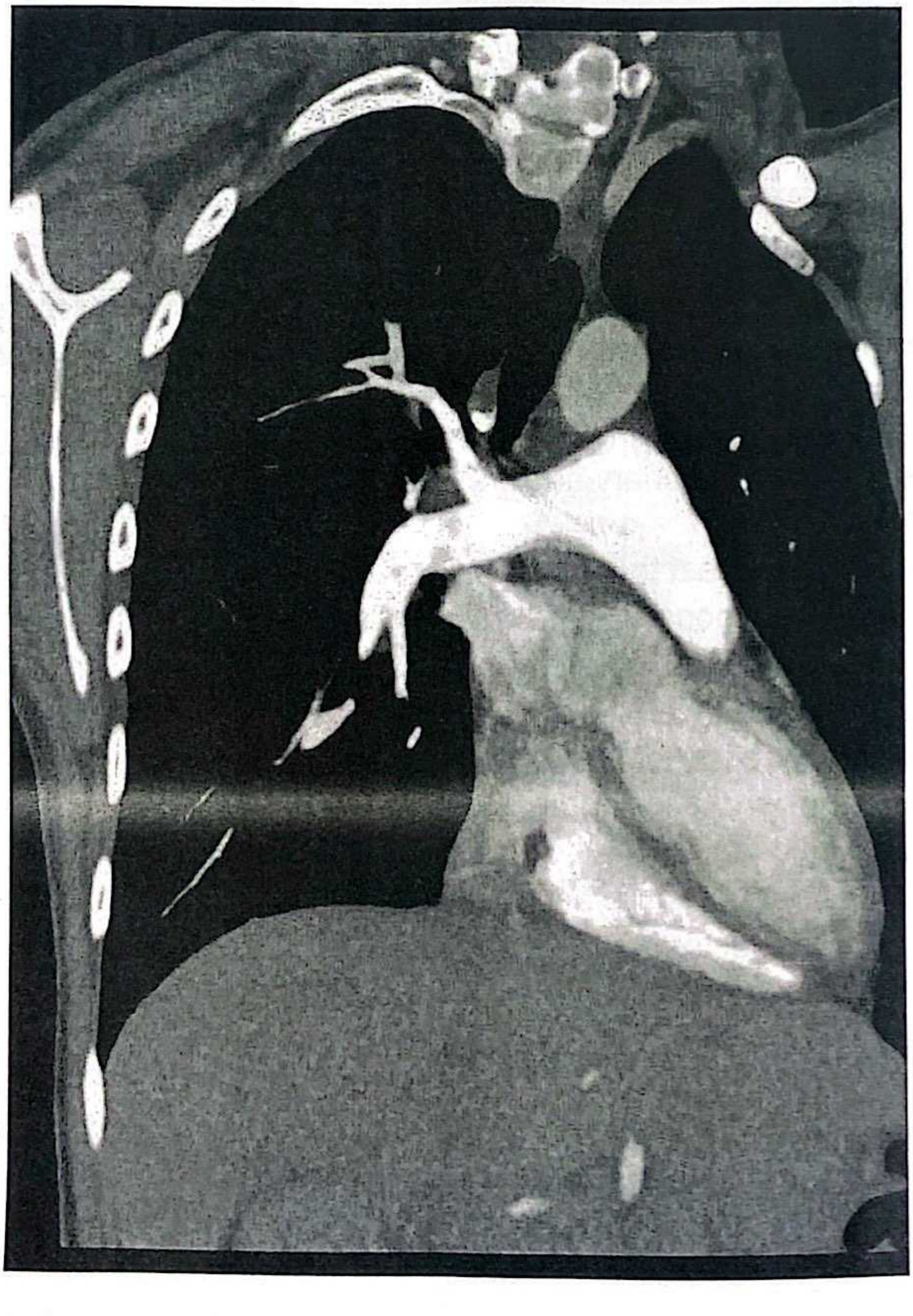
- Anticoagulation
- Thrombolysis is an option
- Embolectomy
- Placement of vena caval filters

Complications

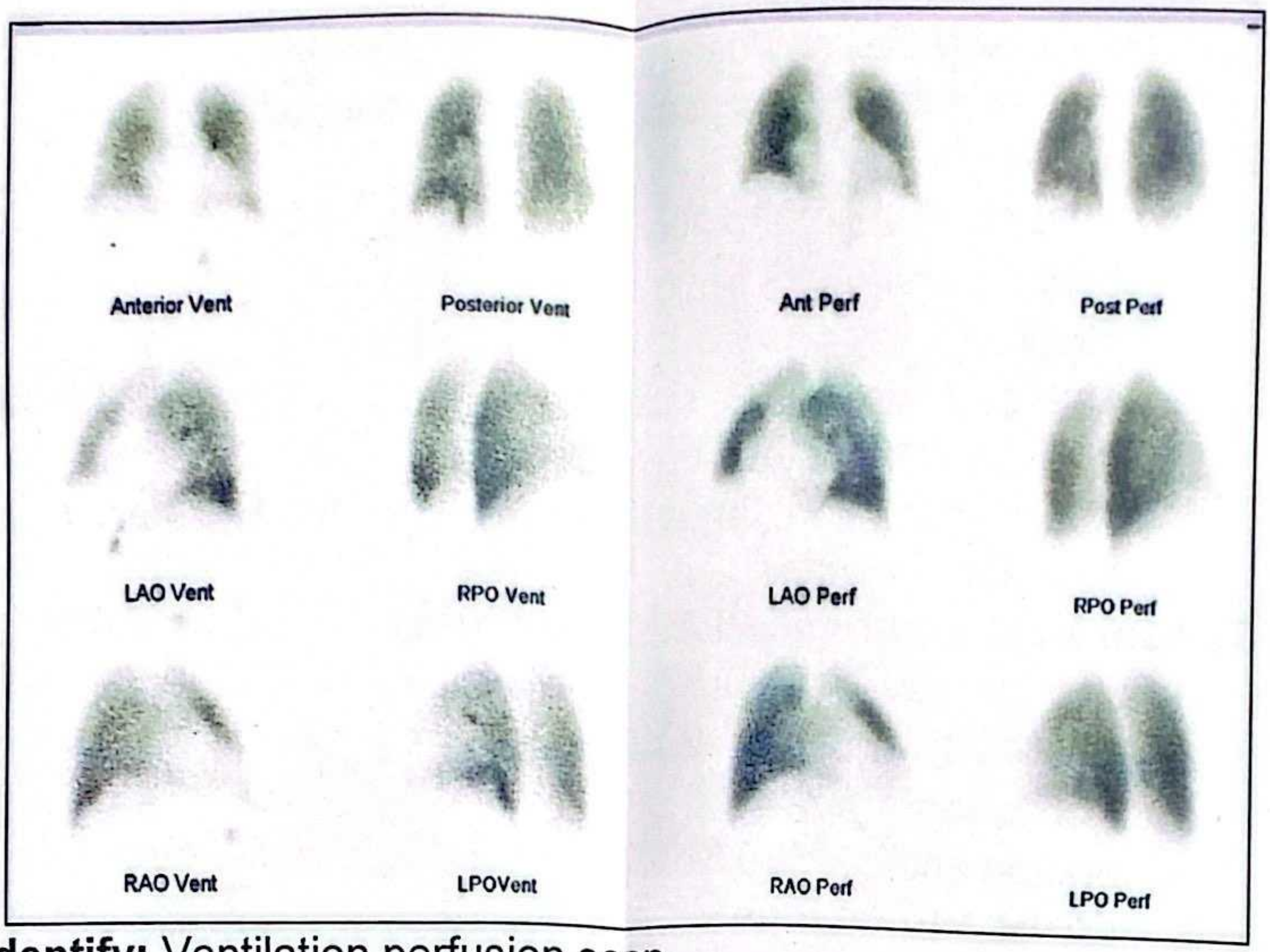
- Acute emboli
- Pulseless electrical activity (PEA) in the context of a large obstructing saddle embolus
- Acute or chronic emboli
- Right ventricular dysfunction

Where do you put ROI for performing pulmonary angiogram and what is the density for it?

- Optimal results are achieved on multislice CT scanners using the thinnest collimation available. We inject 100 ml of non-ionic contrast (density 320-350 mg I/ml) at 4 ml/sec using a power injector. Once the Hounsfield units (HU) in a predefined region of interest in a dynamic scan through the main pulmonary arteries exceed a preset threshold (100 HU), the CTPA acquisition is started. Scanning is performed in caudocranial direction during a breath hold.



Q.15) **(2014)**


Anterior Vent
Posterior Vent
Ant Perf
Post Perf
LAO Vent
RPO Vent
LAO Perf
RPO Perf
RAO Vent
LPOVent
RAO Perf
LPO Perf

Identify: Ventilation perfusion scan

Indications:

- Diagnosis of suspected pulmonary embolism (PE)
- Monitor pulmonary function following lung transplant
- Preoperative estimates of lung function in lung cancer patients
- Before pneumonectomy

Which agents/Radionuclides used:

- The ventilation scan performed using radio-isotope labelled aerosols like **Technetium-99m DTPA** delivered to the patient through a non-rebreathing mask, with the patient supine.

Xenon-133

- Physical half-life: 5.24 days
- Biologic half-life: 2-3 min
- Inhalation of this gas can also be used to assess cerebral blood flow.

Xenon-127

- cyclotron-produced with high cost
- Physical half-life: 36.4 days
- 203 keV

Advantages:

(1) High photon energy allows ventilation study following perfusion study

(2) Decreased radiation dose (0.3 rad)

(3) Storage capability because of long physical half-life

Krypton-81m

- Physical half-life: 13 sec
- Biologic half-life: <1 min
- 190 keV
- The perfusion lung scan involves injecting **Tc-99m MAA** intravenously in the supine position.
- A high resolution, large field of view **gamma camera** is used to image the lungs.

Tc-99m Macroaggregated Albumin (MAA)

- Biologic half-life: 6 hr
- Dose: approximately 2-4-6 mCi
- **Perfusion agent**
- photon energy: 140 KeV

Uses, doses and timings

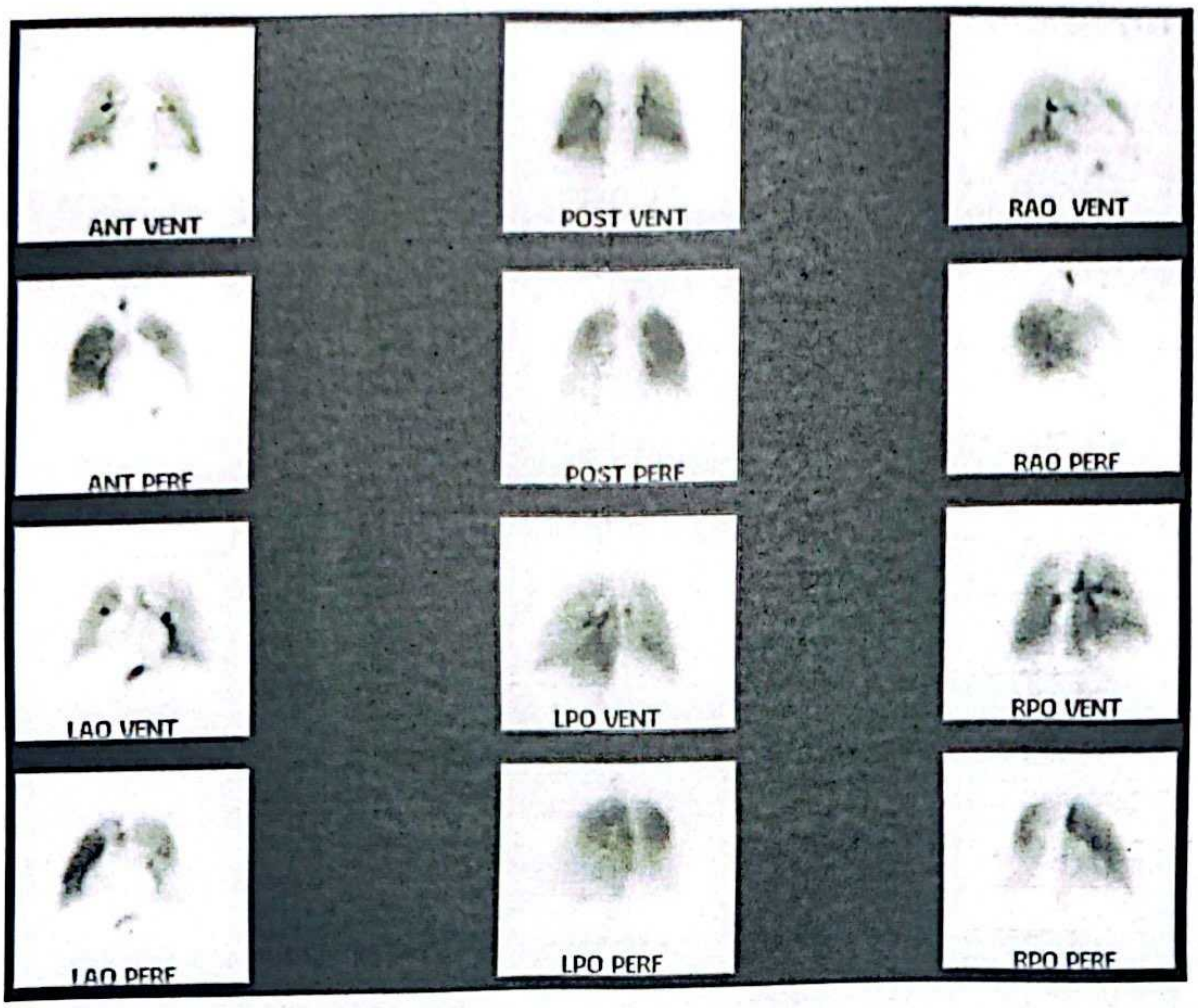
- Timing: immediate
- Pulmonary hypertension, R-L shunt, single lung transplantation
- Pregnant patients
- Paediatric patients: weight-related dosing advised
- blood should not be drawn back into the syringe to ensure needle is in vein before injection (in contrast, to other studies).
- Blood causes MAA aggregation which results in hot pulmonary micro emboli
- **Brain uptake is diagnostic of R-L shunt**

When to label pulmonary embolism?

- A normal ventilation scan (even distribution of radionuclide throughout the lung fields) with multiple, bilateral perfusion defects are the classical findings of pulmonary embolism.

Causes of ventilation/perfusion mismatch include:

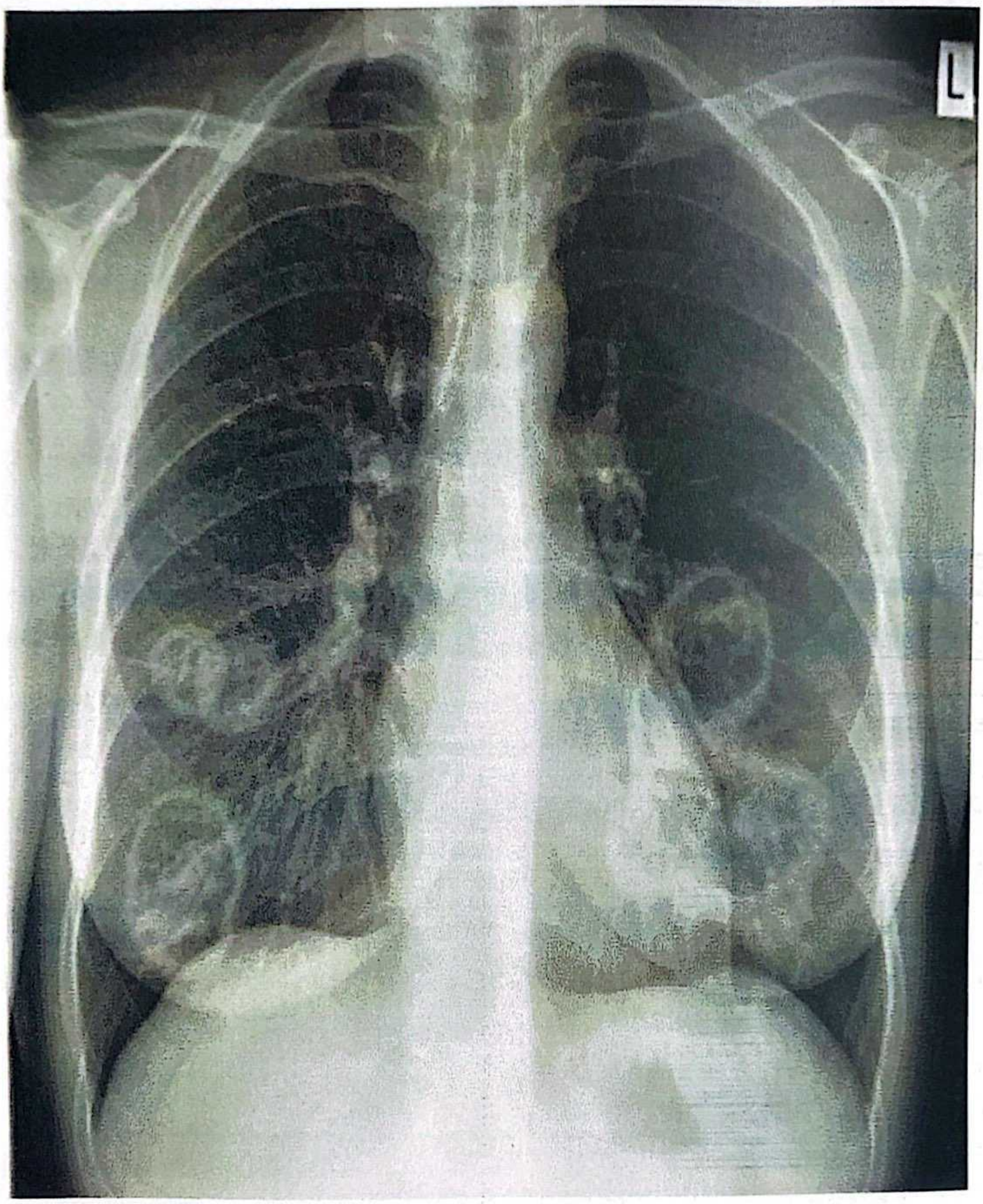
- Acute pulmonary embolism
- Chronic pulmonary embolism
- Obstruction of an artery by a tumour
- Radiation therapy


ANT VENT
POST VENT
RAO VENT
ANT PERF
POST PERF
RAO PERF
LAO VENT
LPO VENT
RPO VENT
LAO PERF
LPO PERF
RPO PERF

Bilateral major mismatch defect consistent with high probability pulmonary embolism.

Normal	No perfusion deficit	Excludes pulmonary thromboembolism
Low probability	Perfusion deficit with matched ventilation deficit	< 20% probability of PE
Intermediate probability	Perfusion deficit that corresponds to parenchymal abnormality on chest x-ray	20% - 80% probability of PE
High probability	Multiple segmental perfusion deficits with normal ventilation	> 80% probability of PE

Q.16) Rhinitis, sinusitis and otitis media (2015)



Identify: X-ray Chest Frontal Projection

Describe: There are several ill-defined nodular cavities the largest ones containing liquid forming fluid level at right lower lung zone.

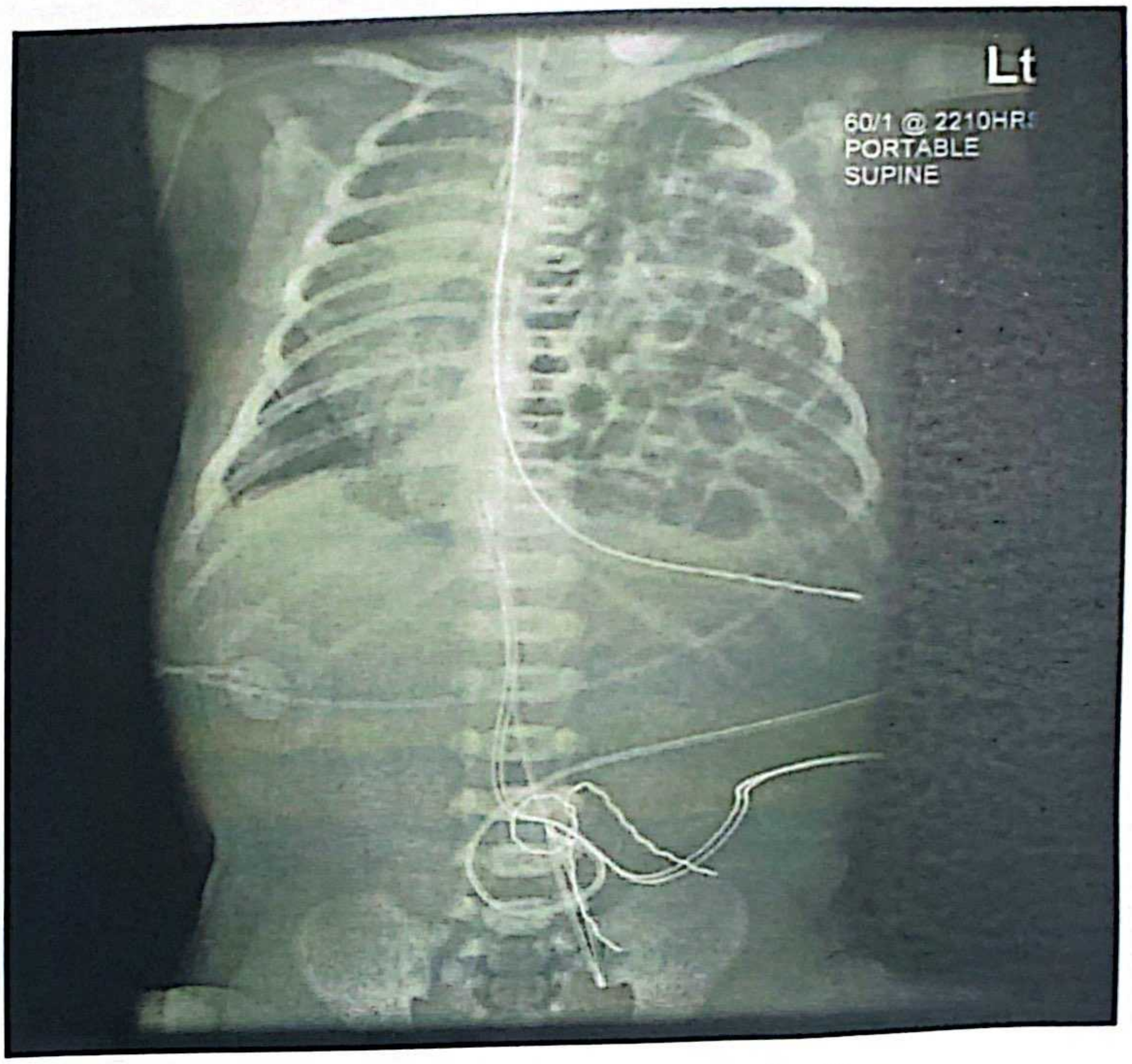
Diagnosis: Granulomatosis with polyangiitis (Wegener granulomatosis).

What next: Contrast enhanced CT chest Abdomen to see other organs involvement, cANCA (PR3) levels., CT PNS to see paranasal sinus involvement

Differential diagnosis

- Churg-Strauss syndrome
- Lymphomatoid granulomatosis
- Sarcoidosis

Q.17) Respiratory distress-Neonate (2015)



Identify: X-ray Chest of neonate Frontal Projection

Describe: Left hemithorax to be filled with multiple radiolucent regions, with displacement of the cardiac silhouette to the right. The nasogastric tube passes towards the left. Umbilical catheters are in situ. No convincing gas containing loops of bowel can be seen in the abdomen.

Diagnosis: Congenital diaphragmatic hernia (Bochdalek hernia)

Differential Diagnosis:

- CCAM
- Pulmonary sequestration

Two main types of diaphragmatic hernia?

- Bochdalek and Morgagni hernia.

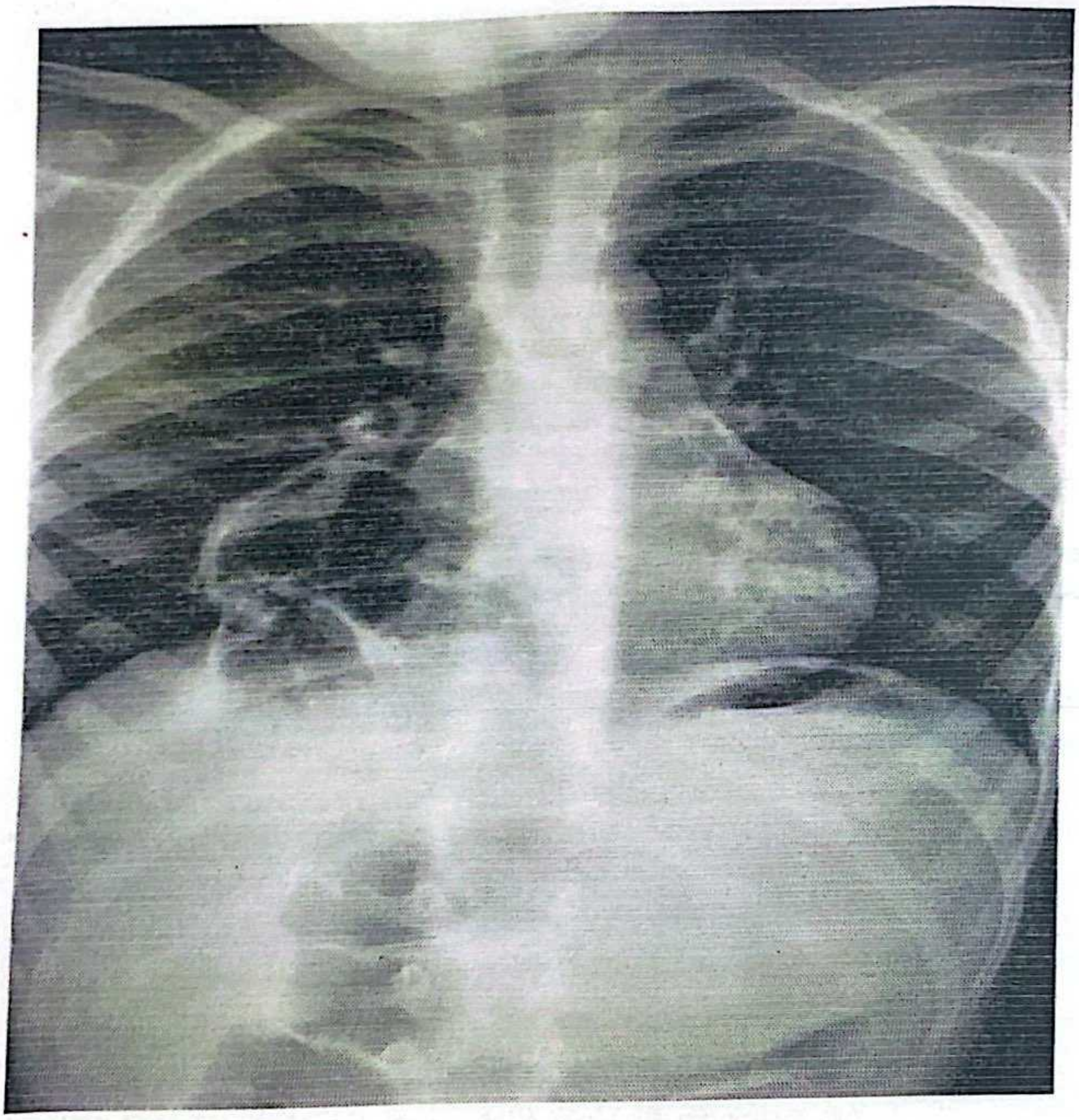
Which has the poorer prognosis and why?

A: Bochdalek; larger and associated with pulmonary hypoplasia.

Mnemonic

B: Bochdalek
B: big
B: back and medial, usually on the left side
B: baby
B: bad (associated with pulmonary hypoplasia)

Q.18) Acute intestinal obstruction-5 years-Male (2016)



Identify: X-ray Chest of neonate Frontal Projection

Describe: Multiple air-filled structures seen in the lower chest and to the right of the cardiac borders.

The stomach is normally seen at the left upper quadrant.

Diagnosis: Morgagni hernia

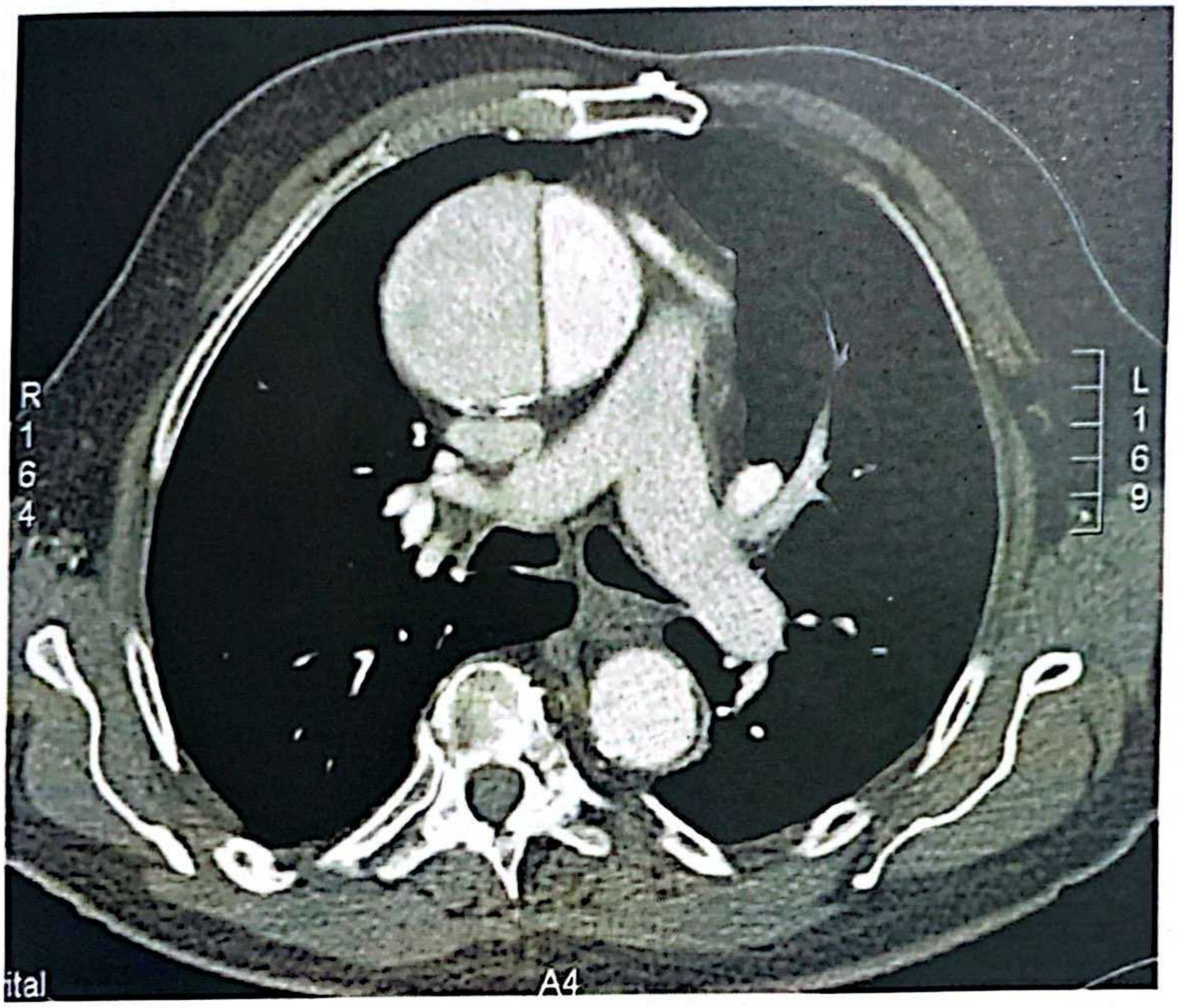
Differential diagnosis:

The main differential diagnosis for Morgagni hernia is a cardiophrenic fat pad. Other cardiophrenic angle lesions can be considered in the differential diagnosis on chest radiograph, although Morgagni hernia is relatively radiolucent compared with other lesions not containing fat.

Treatment:

Laparoscopic surgical repair

Q.19) **(2015)**

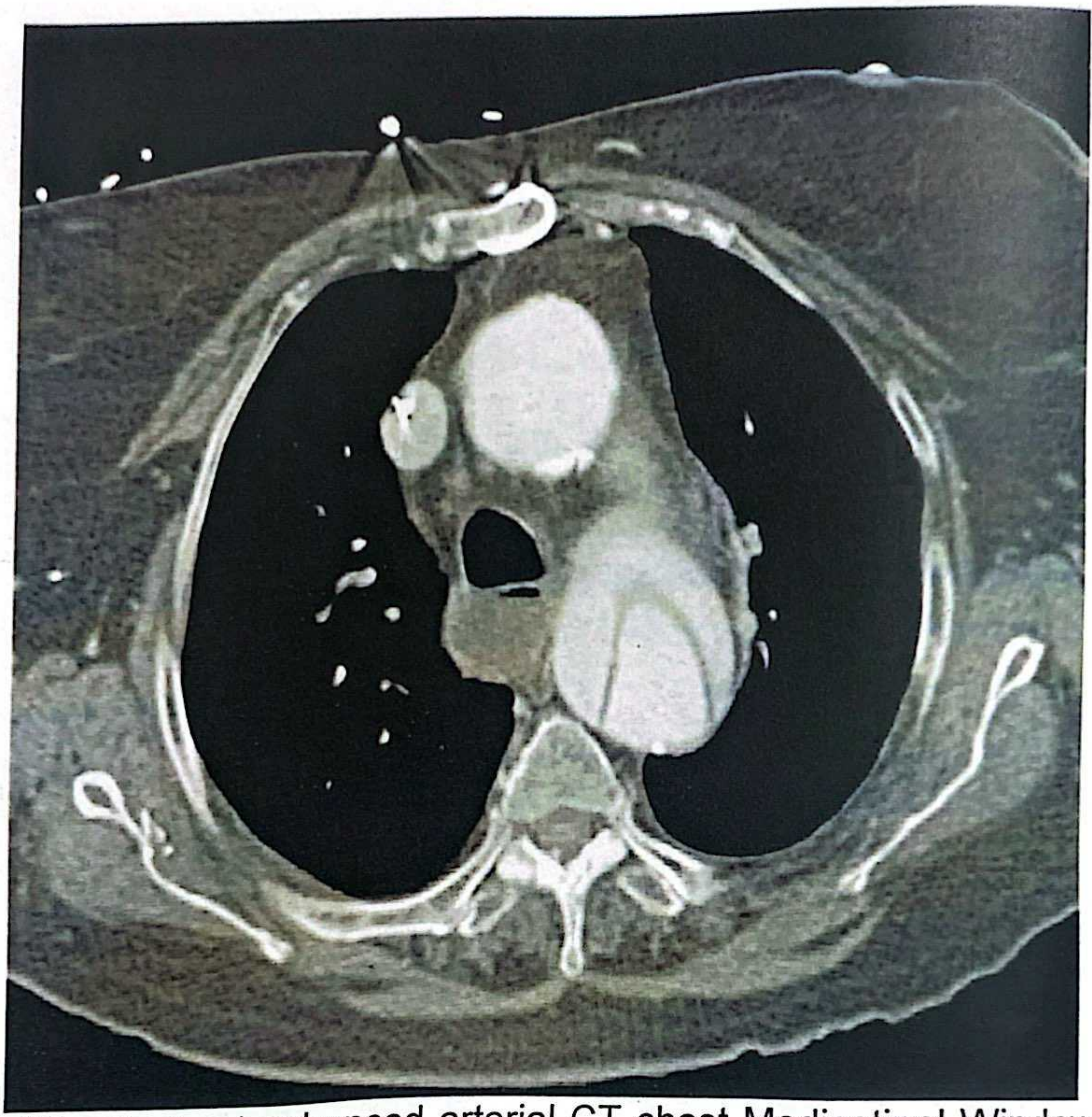


Type A aortic dissection

Thoracic aortic dissection is commonly divided according to the Stanford classification into type A (involving the ascending aorta or aortic arch) and type B (involving the descending thoracic aorta only). The main causes of dissection are hypertension, atherosclerosis, Marfan's syndrome, Ehlers-Danlos syndrome, vasculitis, pregnancy and iatrogenic (aortic catheterisation).

Complications of aortic dissection include dissection and occlusion of branch vessels, distal thromboembolism, aneurysmal dilatation and aortic rupture. Type A dissection may also result in coronary artery occlusion, aortic regurgitation and pericardial tamponade and therefore management of this type of dissection is usually emergency surgical repair. Type B dissections are usually managed with aggressive blood pressure control unless there are complications.

Q.20) (2018)



Identify: Contrast enhanced arterial CT chest Mediastinal Window Axial Section

Describe: Aortic dissection arising at the level of an aberrant right subclavian artery (which courses behind both trachea and oesophagus).

Diagnosis:

What next:

- No dissection of the ascending aorta can be identified (thus this represents a DeBakey type III, Stanford type B dissection).
- The true lumen in this instance is easily traced as the smaller circular lumen located posteriorly on inferior slices. Calcification on the luminal surface confirms this.

Stanford classification

DeBakey classification

- In recent years, the Stanford classification has gained favour with cardiothoracic surgeons. Approximately 60% of dissections involve the ascending aorta (Stanford A / DeBakey I and II).

Plain radiograph

- widened mediastinum
- double aortic contour
- irregular aortic contour
- inward displacement of atherosclerotic calcification

CT / CT angiography

CT, especially with arterial contrast enhancement (CTA) is the investigation of choice

- intimal flap
- double lumen
- dilatation of the aorta
- Mercedes-Benz sign in the case of a "triple-barreled" dissection
- windsock sign
- beak sign
- cobweb sign

Transoesophageal echocardiography

- Transoesophageal echocardiography (TOE) has very high sensitivity and specificity for assessment of acute aortic dissection

MRI

- MRA has been reserved for follow-up examinations

DSA - angiography

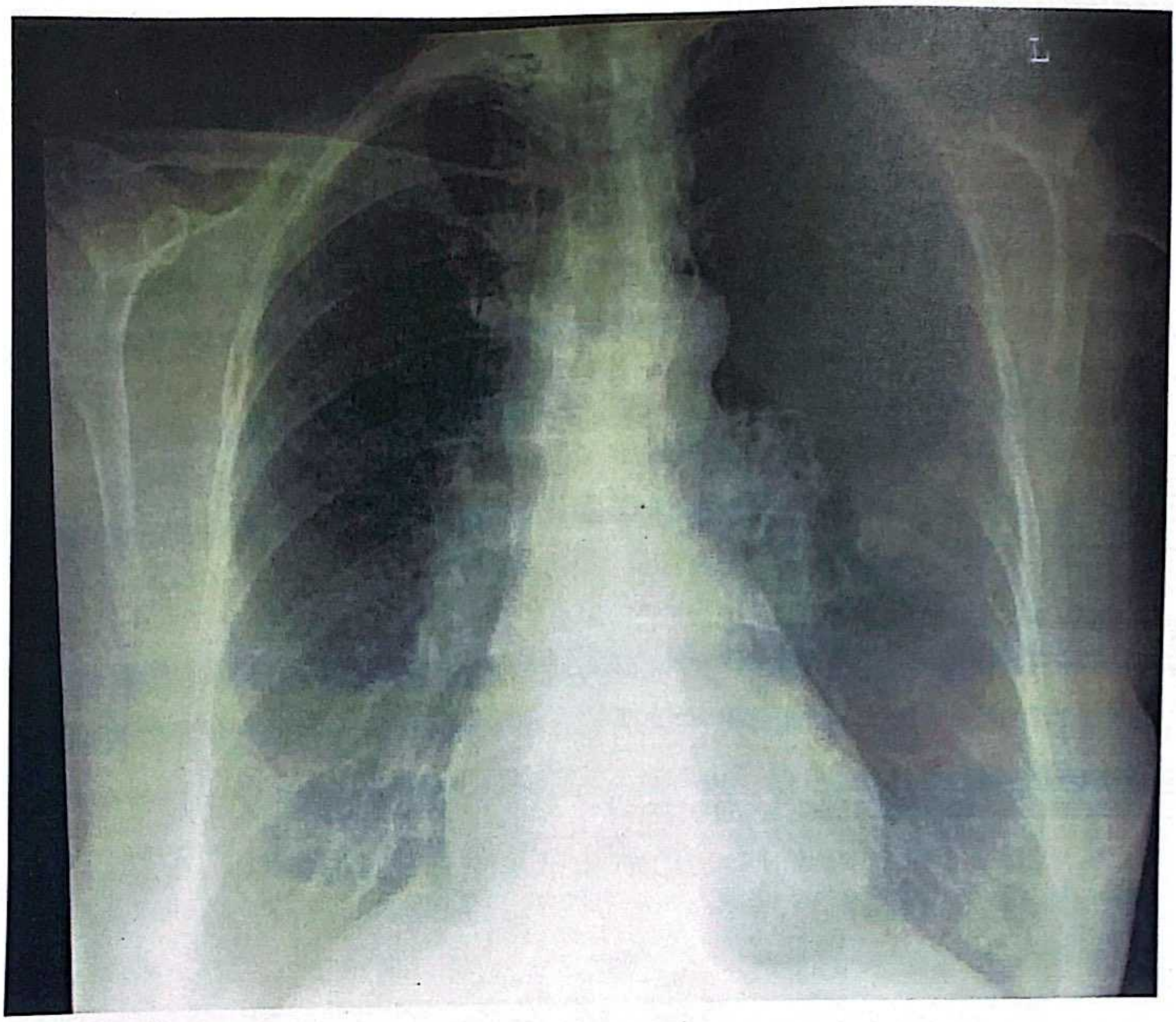
Conventional digital subtraction angiography has historically been the gold standard investigation.

Treatment

aggressive blood pressure control

immediate surgical repair (for type A dissection or complicated type B dissection)

Q.21) **(2015)**



Identify: X-ray Chest Frontal Projection

Describe: Prominent hilar and mediastinal lymph node enlargement.

Diagnosis: Sarcoidosis

What next: HRCT

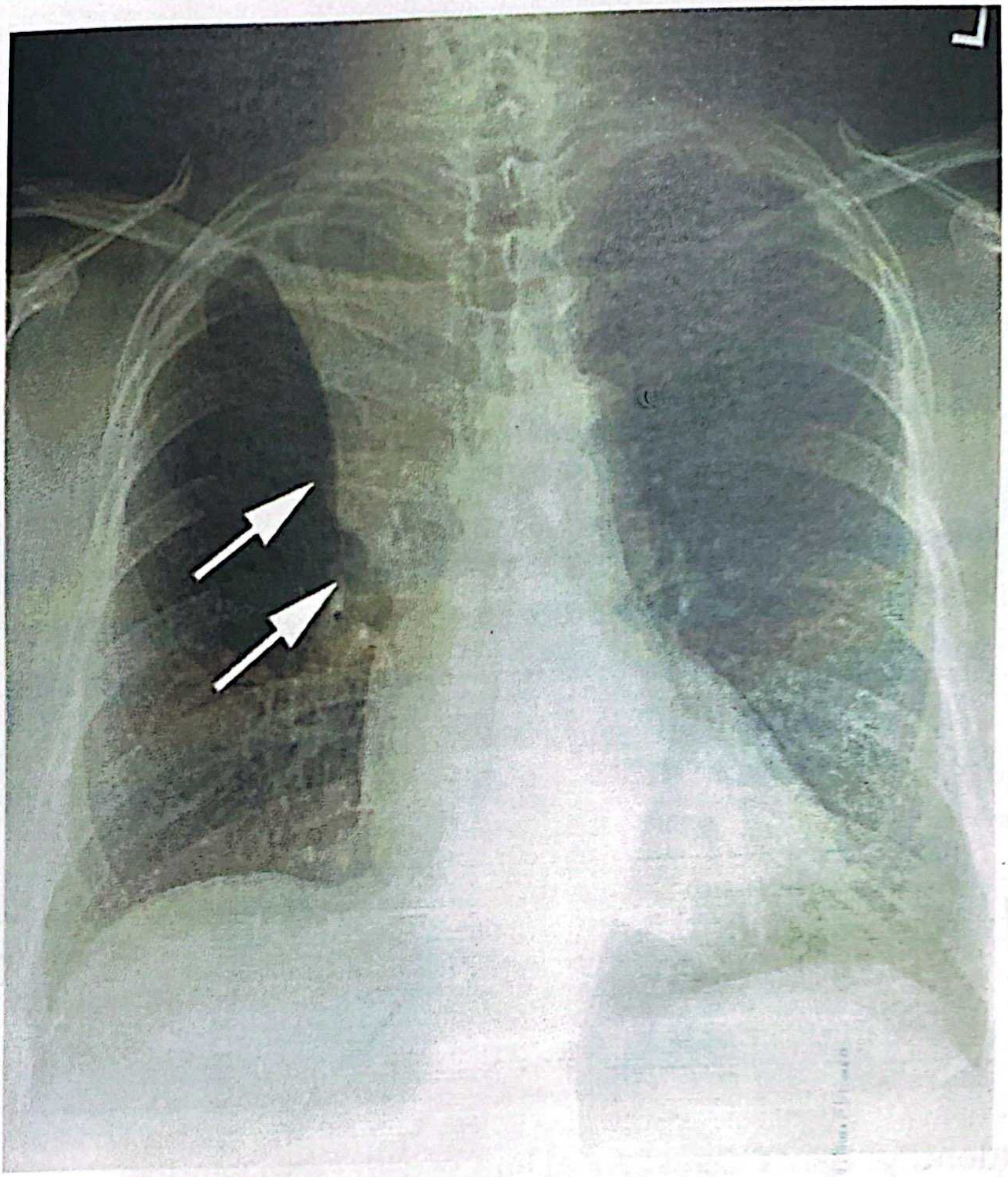
Treatment:

Treatment is primarily with corticosteroids

Complications

- Pulmonary fibrosis (stage IV)
- Pulmonary arterial hypertension and cor pulmonale
- Aspergillomas complicated by haemoptysis

Q.22) (2014), (2018)



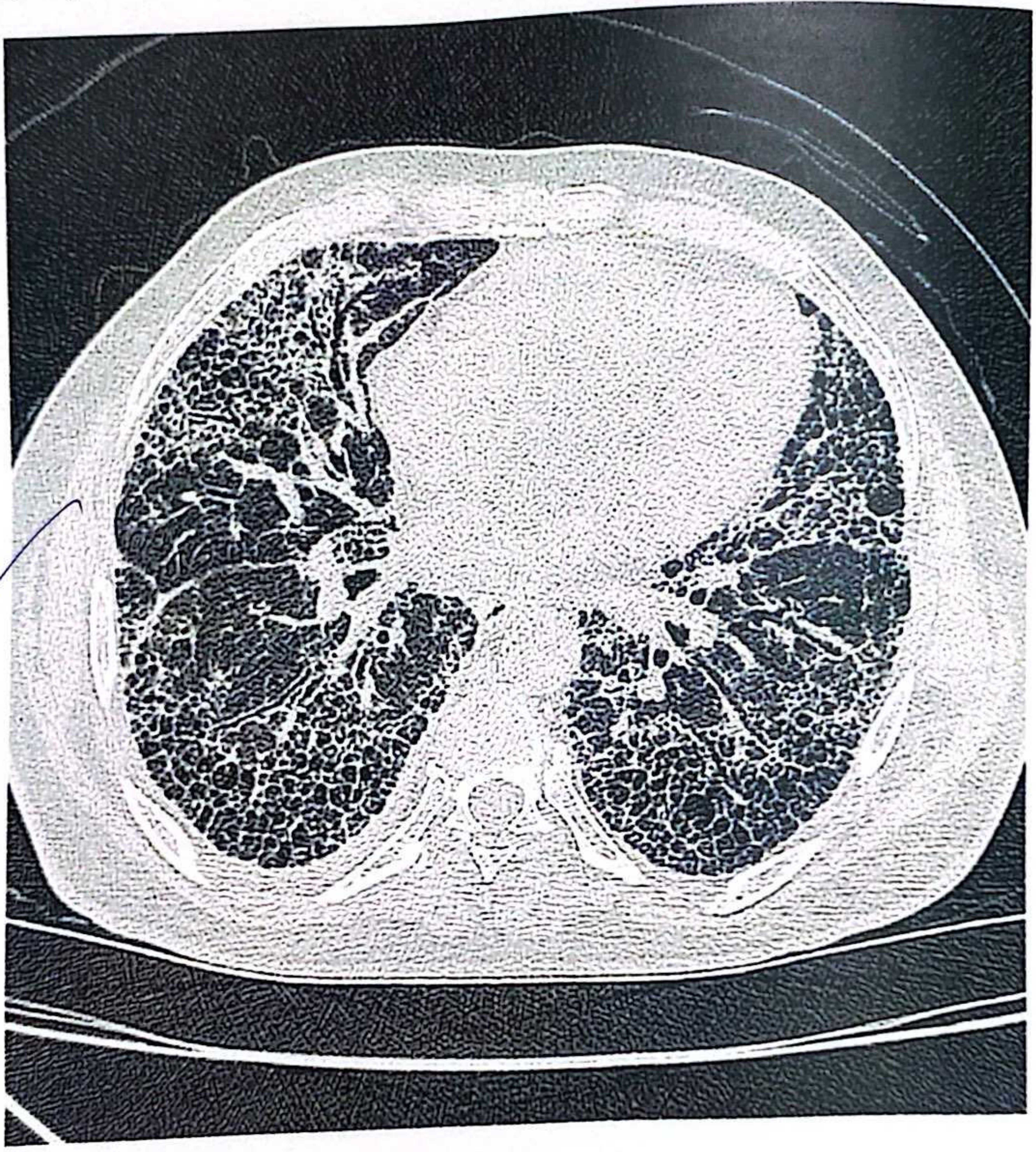
Identify: X-ray Chest Frontal Projection

Describe: Well defined triangular opacity in the right upper zone abutting the right margin of mediastinum without any internal cavitation, calcifications or fluid level. Horizontal fissure is elevated abutting the lateral border of the opacity. Right hilum and hemi-diaphragm are elevated. Right upper ribs are slightly crowded with minimal right tracheal shift.

Diagnosis: Right upper lobe collapse.

What next: Contrast enhanced CT Chest to rule out any Mass/Malignancy

Q.23) (2014)



Identify: HRCT Chest Axial image with Lung window

Describe: Diffuse honey combing in both lungs with interstitial fibrosis more marked in subpleural distribution alongwith traction bronchiectasis and peri bronchial thickening.

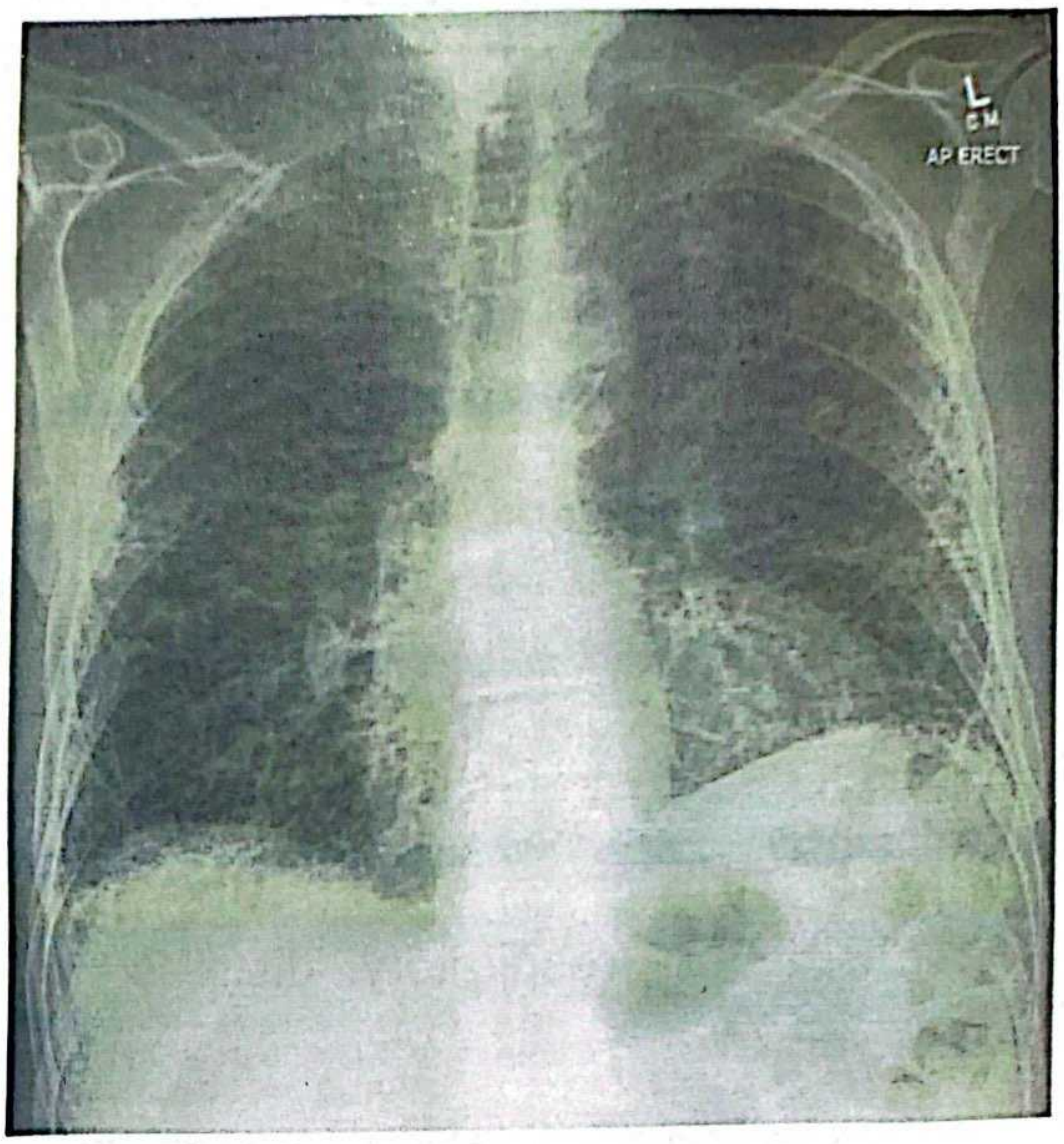
Diagnosis: UIP/Pulmonary fibrosis

What next:

Differential diagnosis:

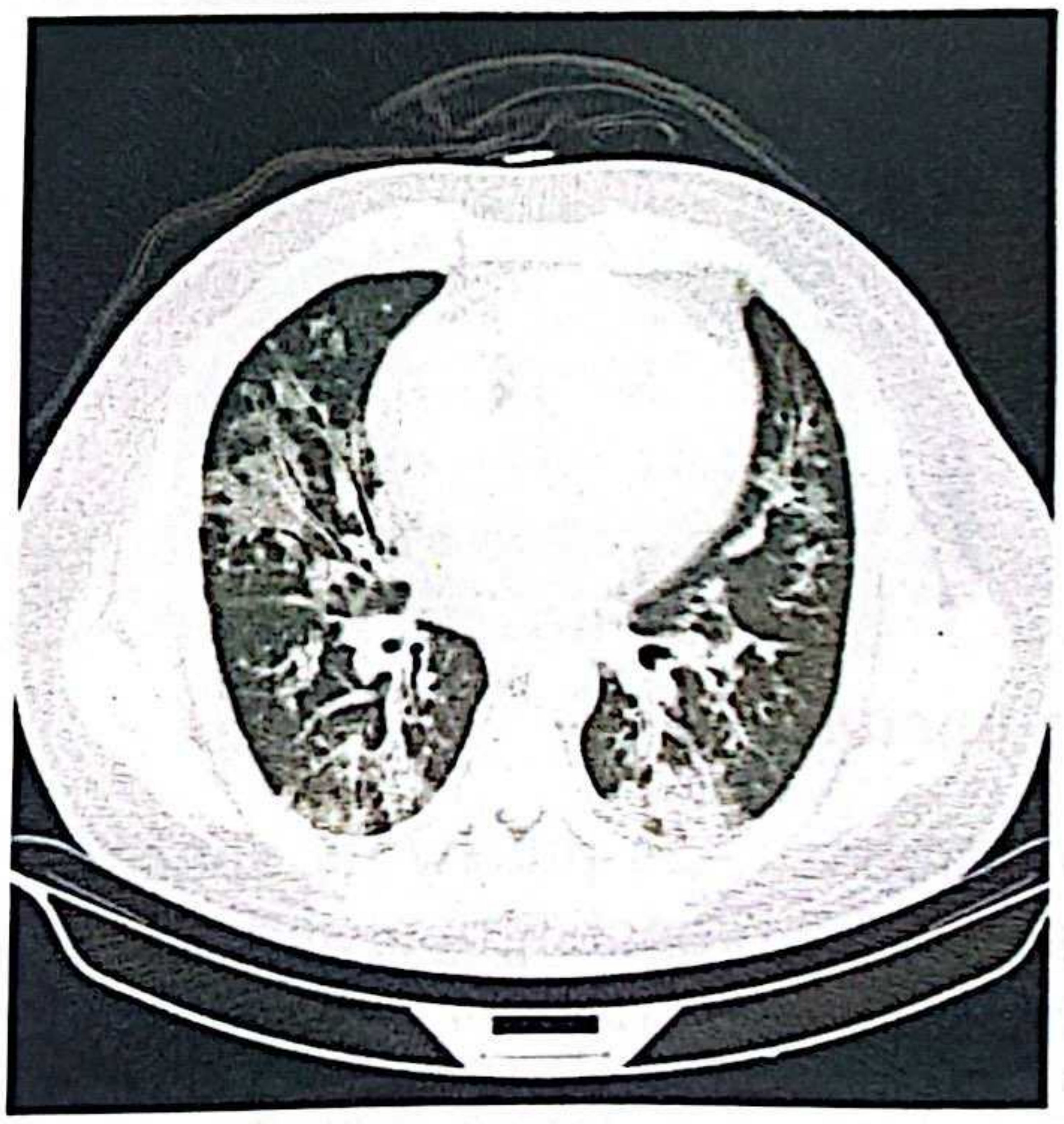
- Nonspecific interstitial pneumonia pattern
- Chronic hypersensitivity pneumonitis
- Amiodarone lung fibrosis
- Systemic sclerosis
- Asbestosis

Q.24)



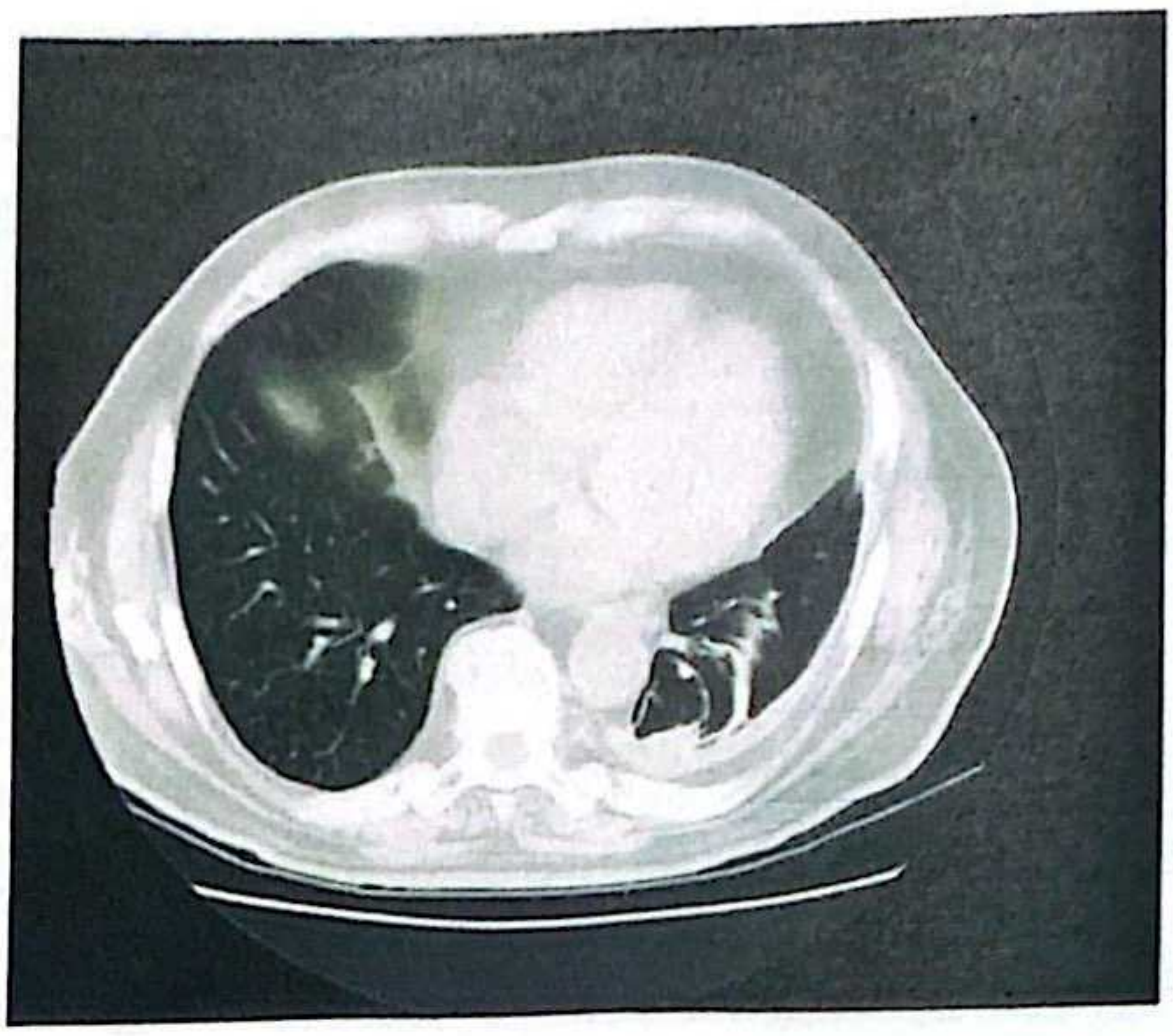
Volume loss. Bilateral peripheral and lower zone reticular interstitial densities. Imaging features most match a pulmonary fibrosis with a UIP type pattern

Q.25) **(2012)**



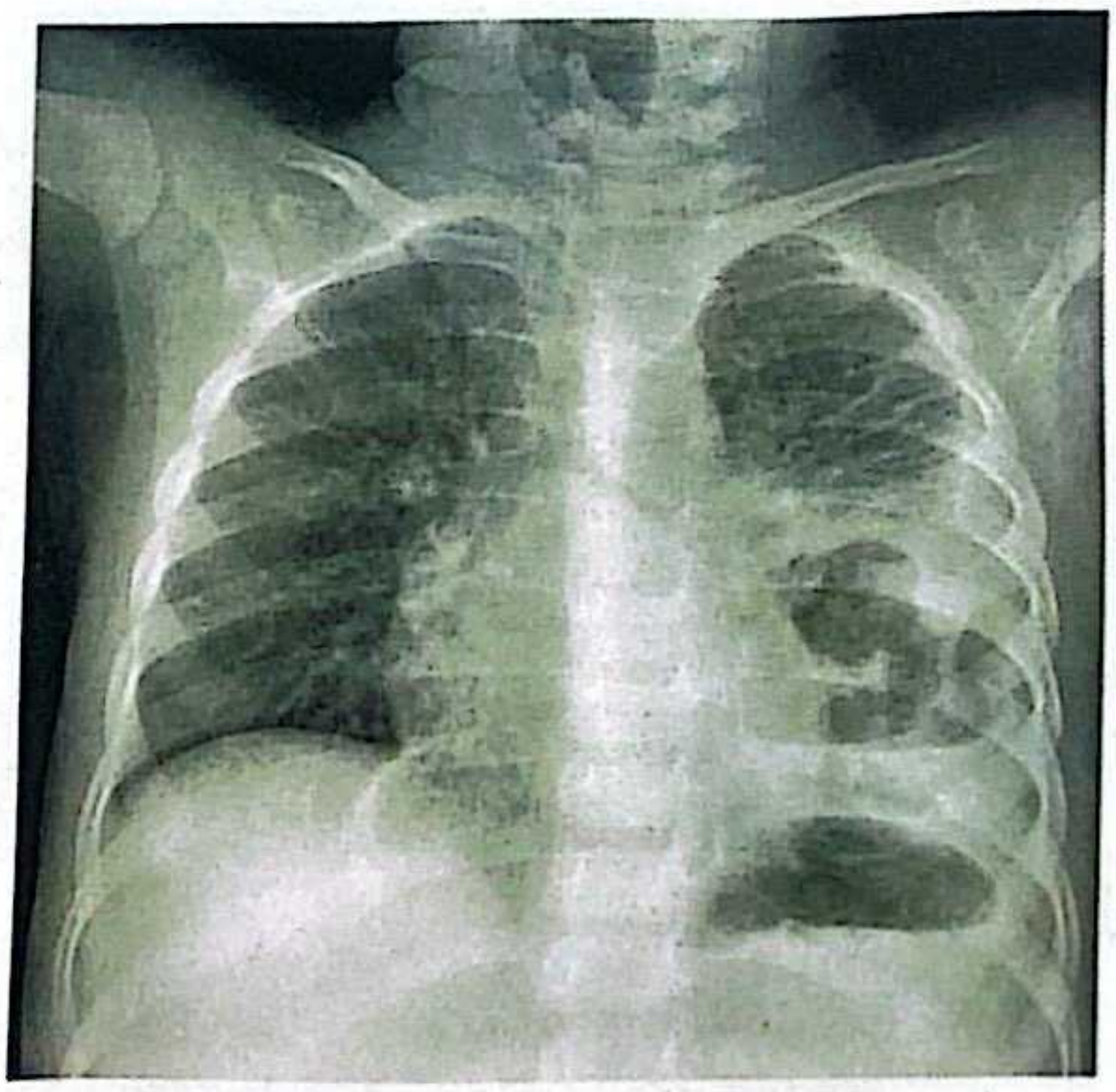
cryptogenic organising pneumonia (COP):
Alveolar and ground glass opacities with a predominantly peripheral and peribronchial distribution are seen particularly at middle and lower zones of the both lungs.

Q.26)



CT of the chest demonstrates round atelectasis in the left base with a comet tail sign.

Q.27) Cough, fever, respiratory distress of 1-week duration-Female-3 Year (2016)

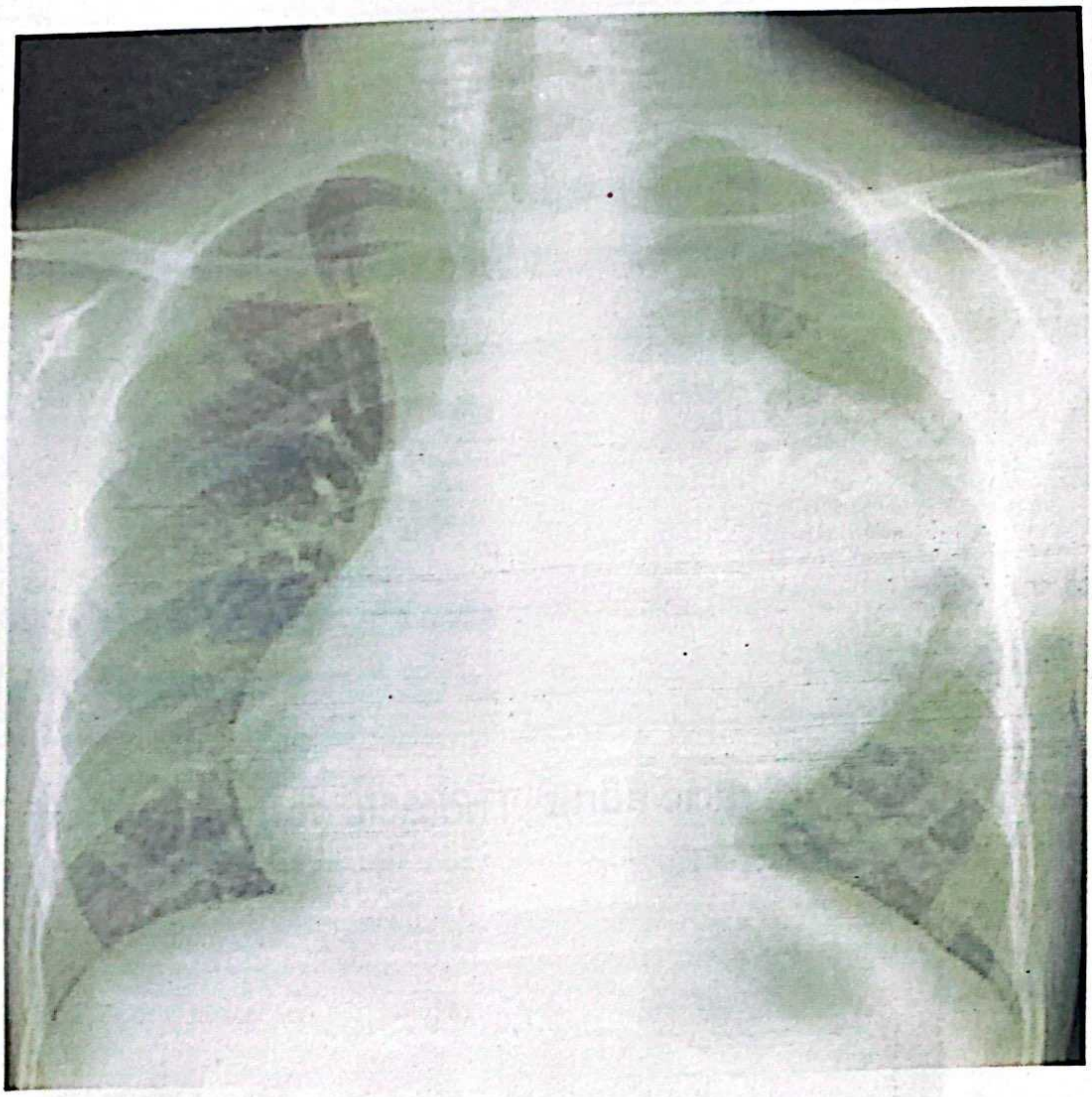


Cavitating pneumonia

The study demonstrates patchy air space consolidation in the left lower lobe with air-bronchogram and evidence of multiple sharply defined, cystic spaces that contain air and minimal fluid consistent with multiple cavities (cavitating pneumonia). The differential diagnosis includes pneumatoceles, which appear as thin wall cystic spaces and follow up after resolution of the consolidation will help in differentiating the two categories.

Small left pleural effusion is noted.

Q.28) (2014)



Teratoma

There is presence of large anterior mediastinal mass measuring 9 cm in size with calcification within it. There is shift of the mediastinum towards right side. No pleural effusion is seen. Findings are most likely suggestive of teratoma.

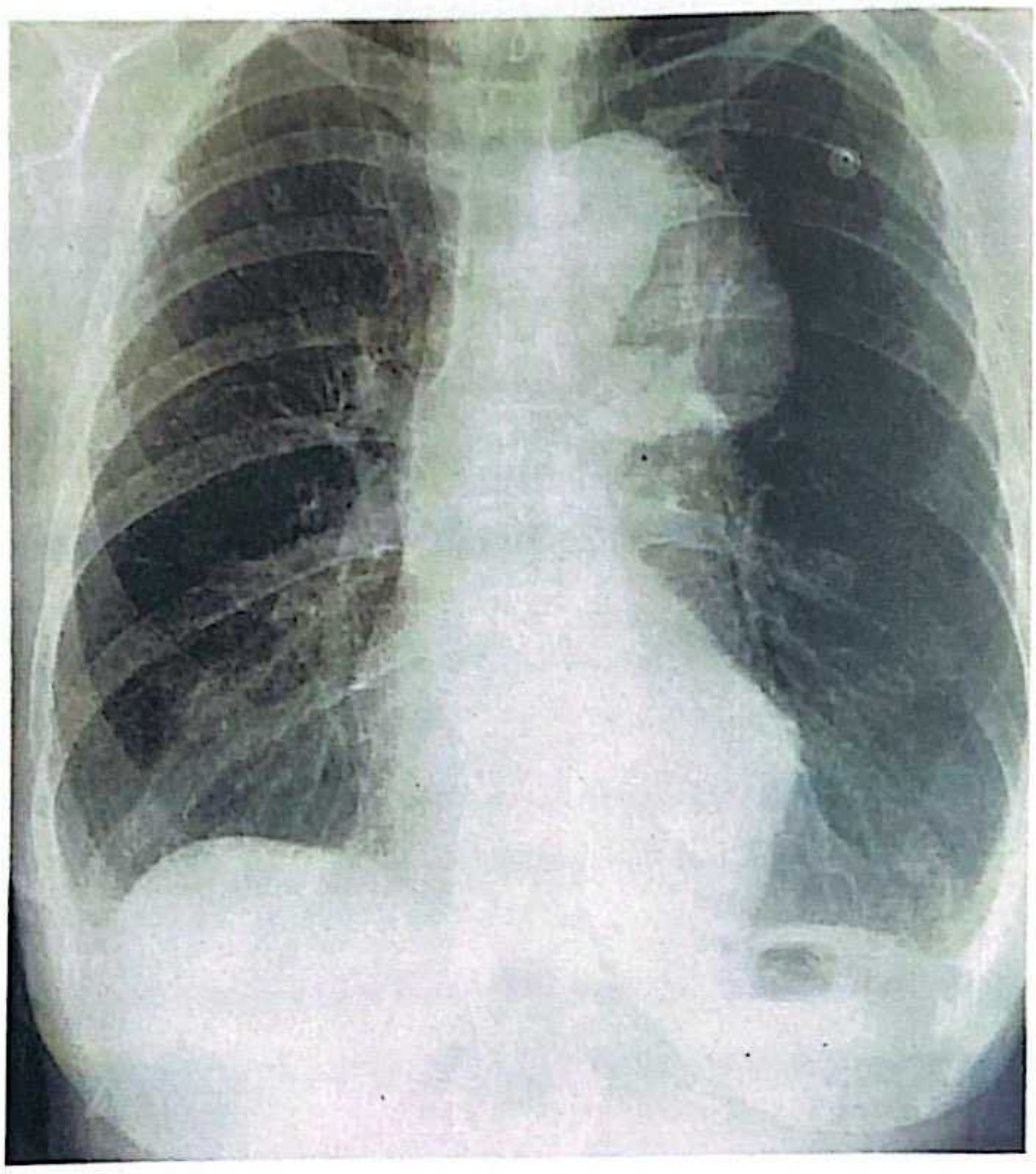
anterosuperior mediastinal mass can be remembered by using the mnemonic:

5 Ts

Mnemonic

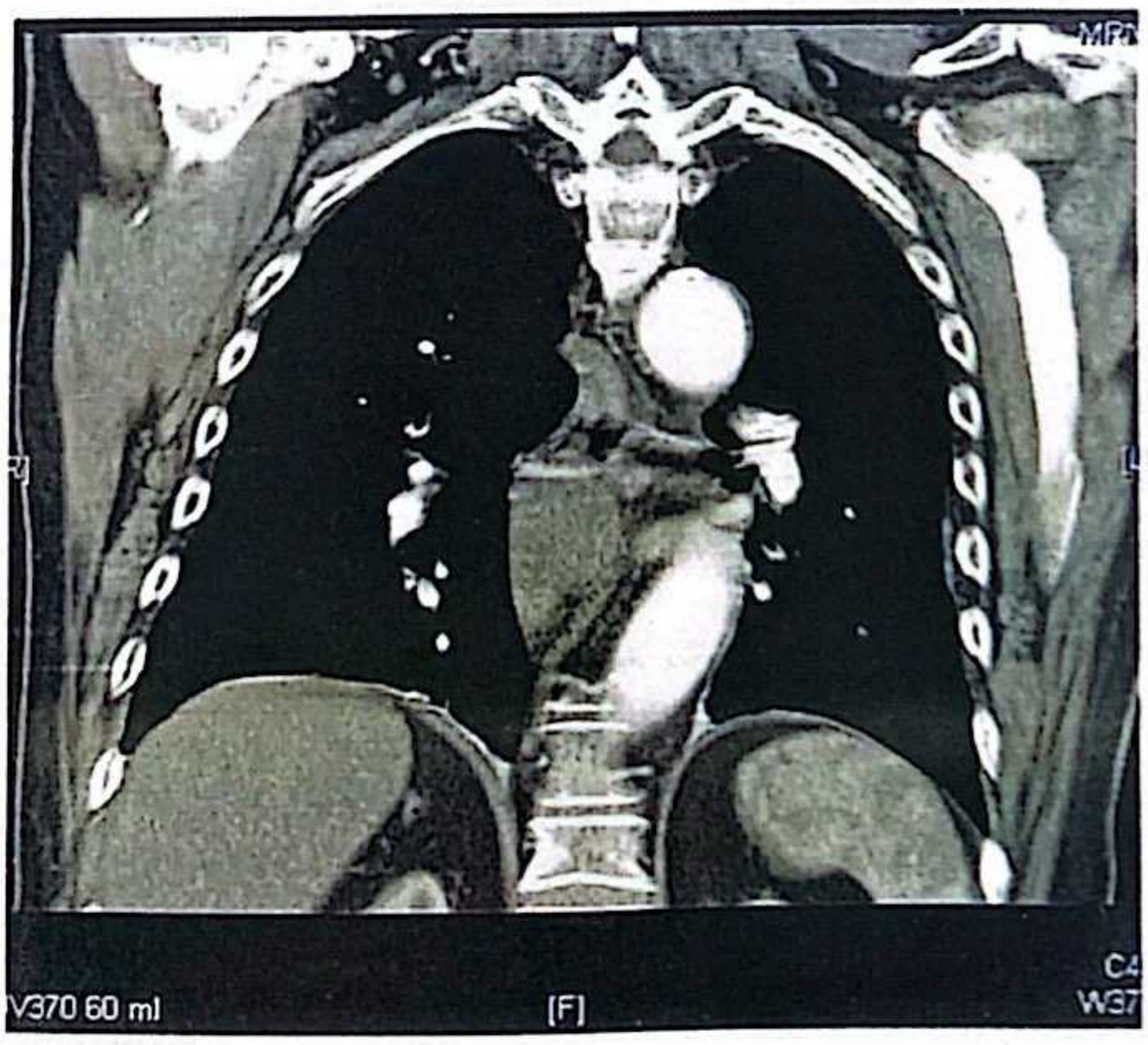
T: thymus
T: thyroid
T: thoracic aorta
T: terrible lymphoma
T: teratoma and germ cell tumours - see mediastinal germ cell tumours

Q.29) **(2015)**



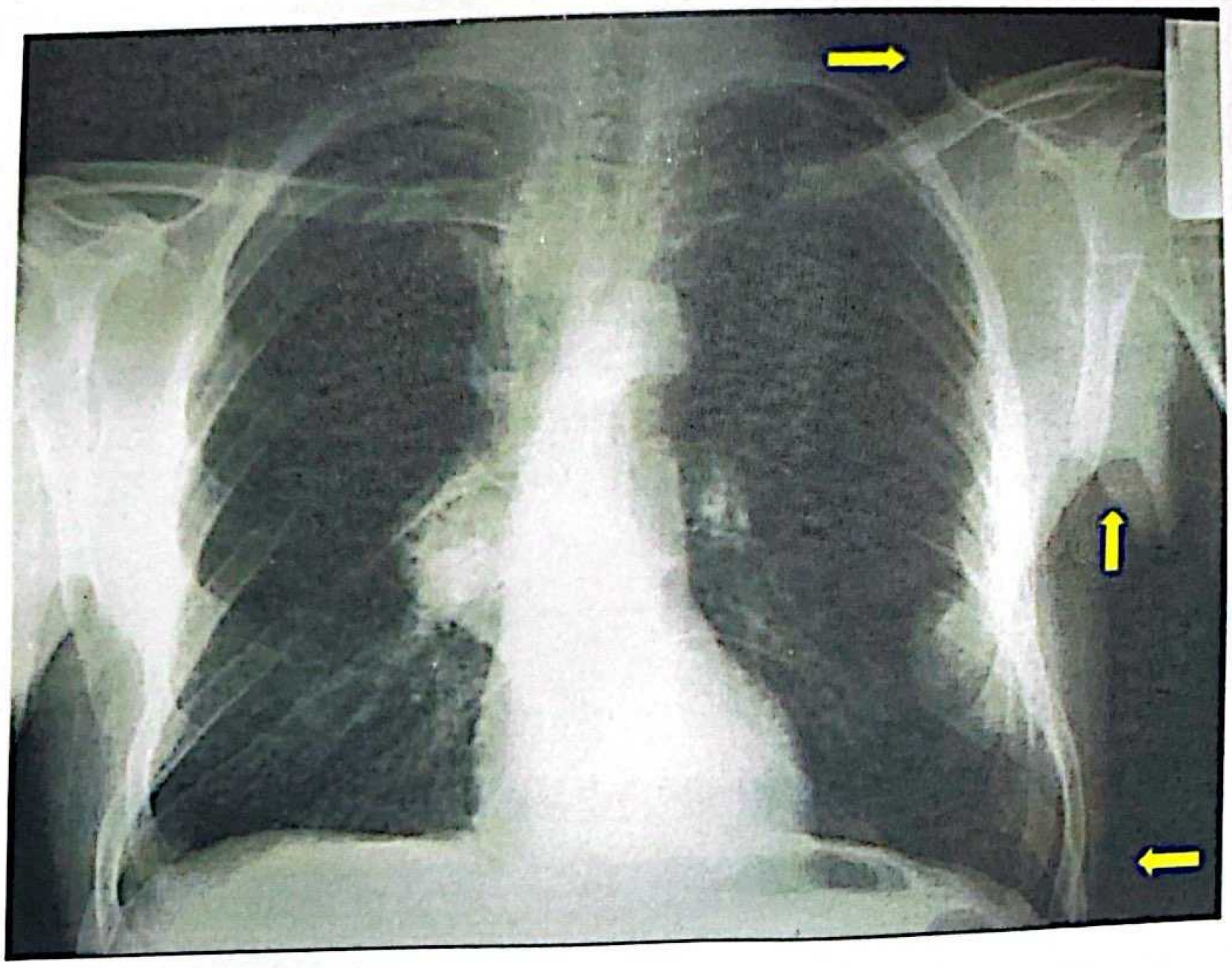
Markedly dilated thoracic aorta- Thoracic aortic aneurysm

Q.30) **(2013)**



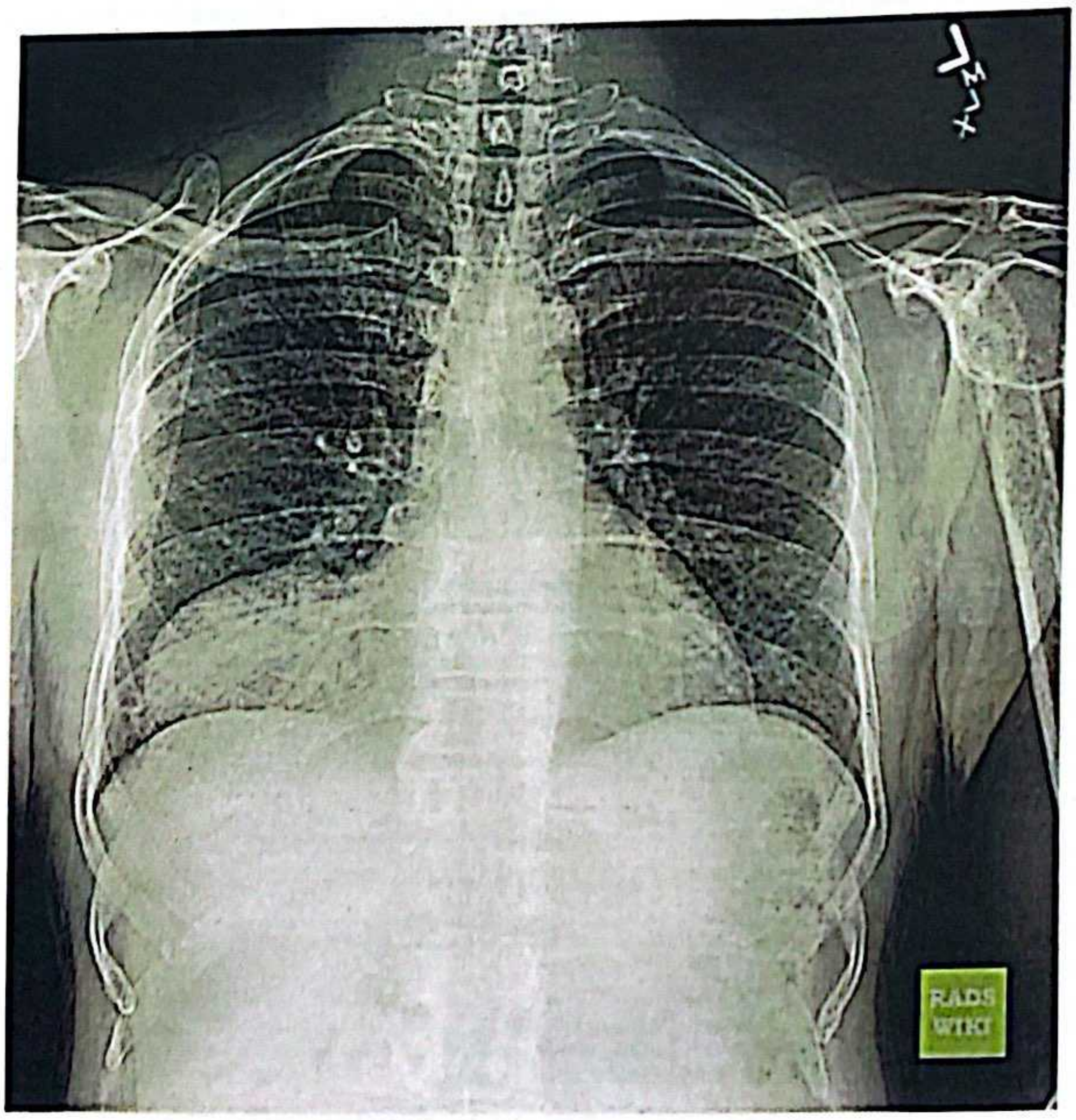
Coronal C+ arterial phase
Foregut duplication cyst.
Incidental finding on CT. In the posterior mediastinum, to the left of the oesophagus and below the level of the carina is a low attenuation non-enhancing mass which abuts and displaces the oesophagus to the right side.

Q.31) **(2014)**



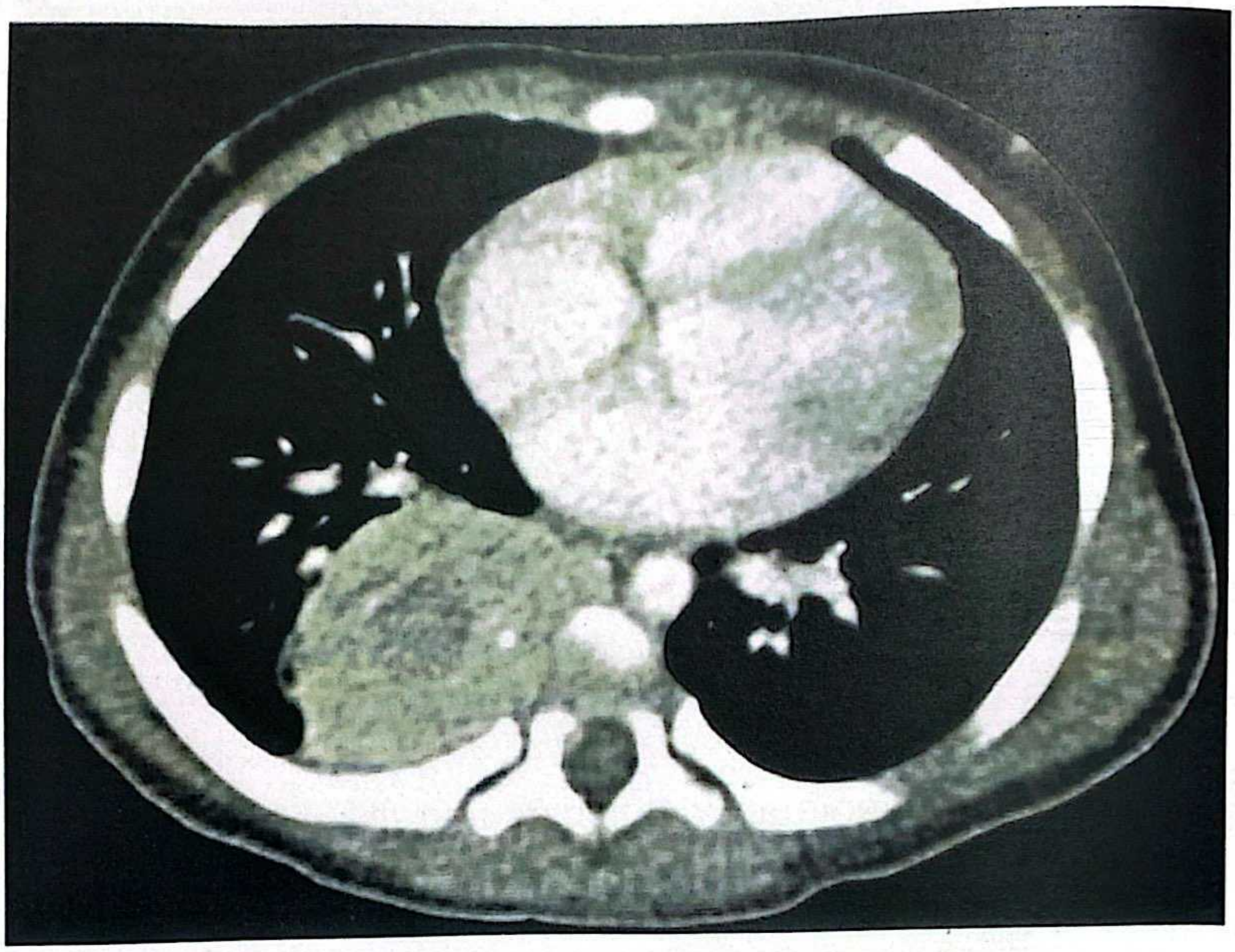
Noted multiple nerve schwannomas and ribbon ribs. Note left skin nodules (yellow arrows).

Q.32) **(2014)**



Pericardial cyst
X-ray shows a well circumscribed mass in contact with right cardiac margin.

Q.33) **(2015)**



Identify: Contrast enhanced arterial CT chest Mediastinal Window Axial Section

Describe: Large right enhancing mass with central hypoattenuation

Diagnosis: Thoracic neuroblastoma

What next:

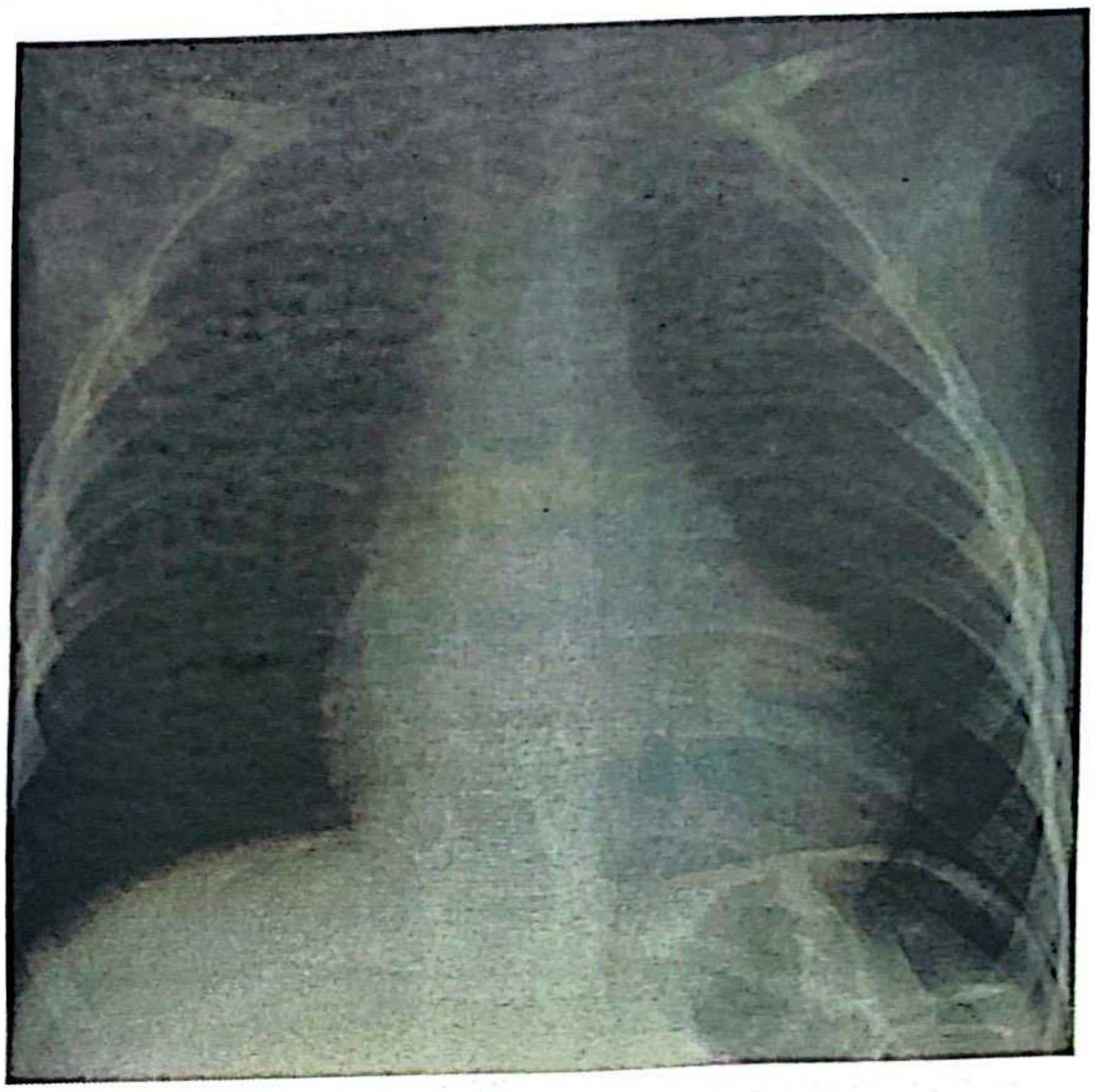
- Contrast enhanced CT Chest
- MRI
- MIBG (metaiodobenzylguanidine labelled to Iodine-123)
- FDG PET/CT
- Tc-99m MDP

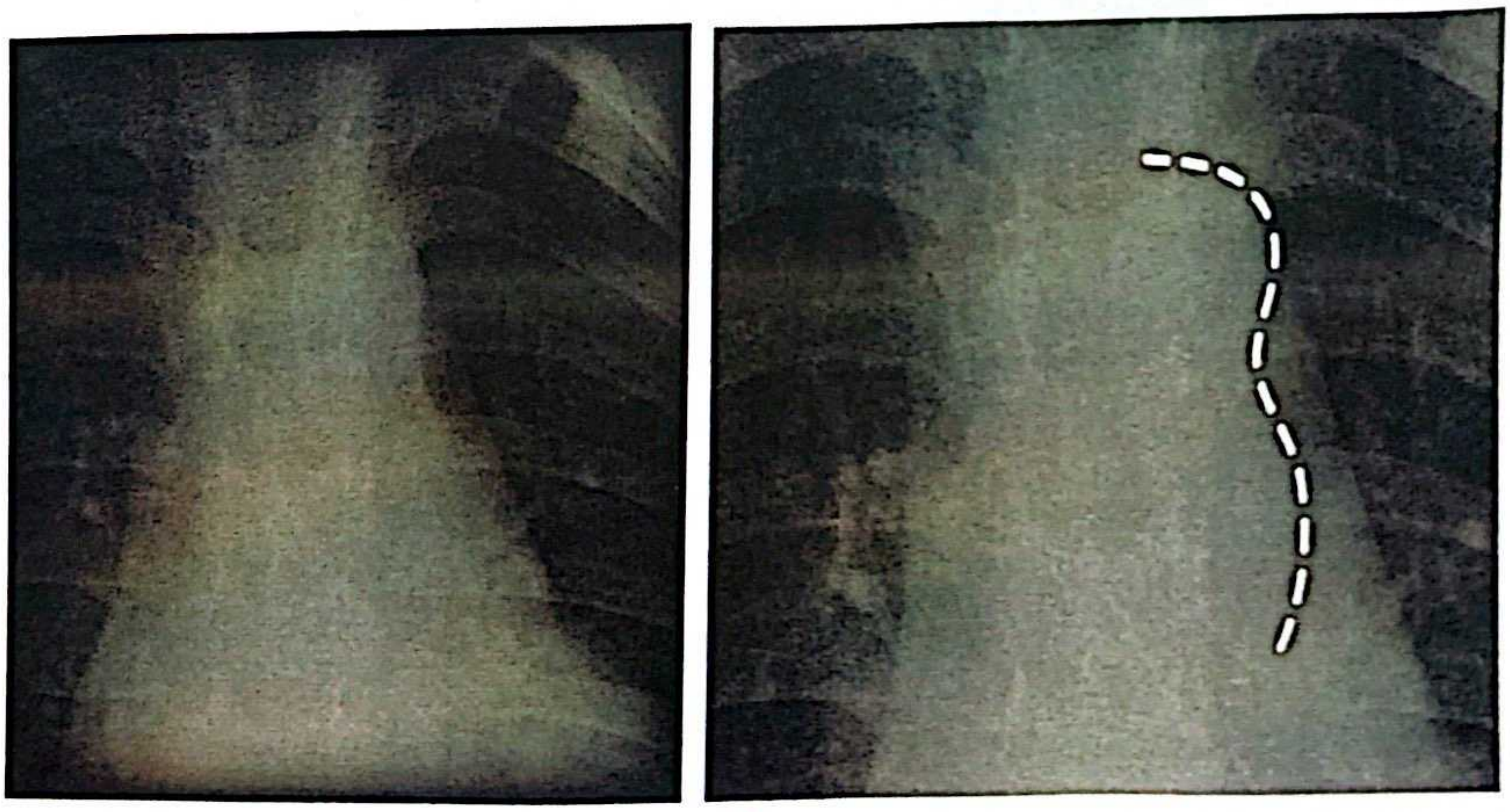
Differential diagnosis:

- intrathoracic lymphoma
- extralobar pulmonary sequestration
- round pneumonia
- ganglioneuroma
- ganglioneuroblastoma

Q.34) **(2013)**

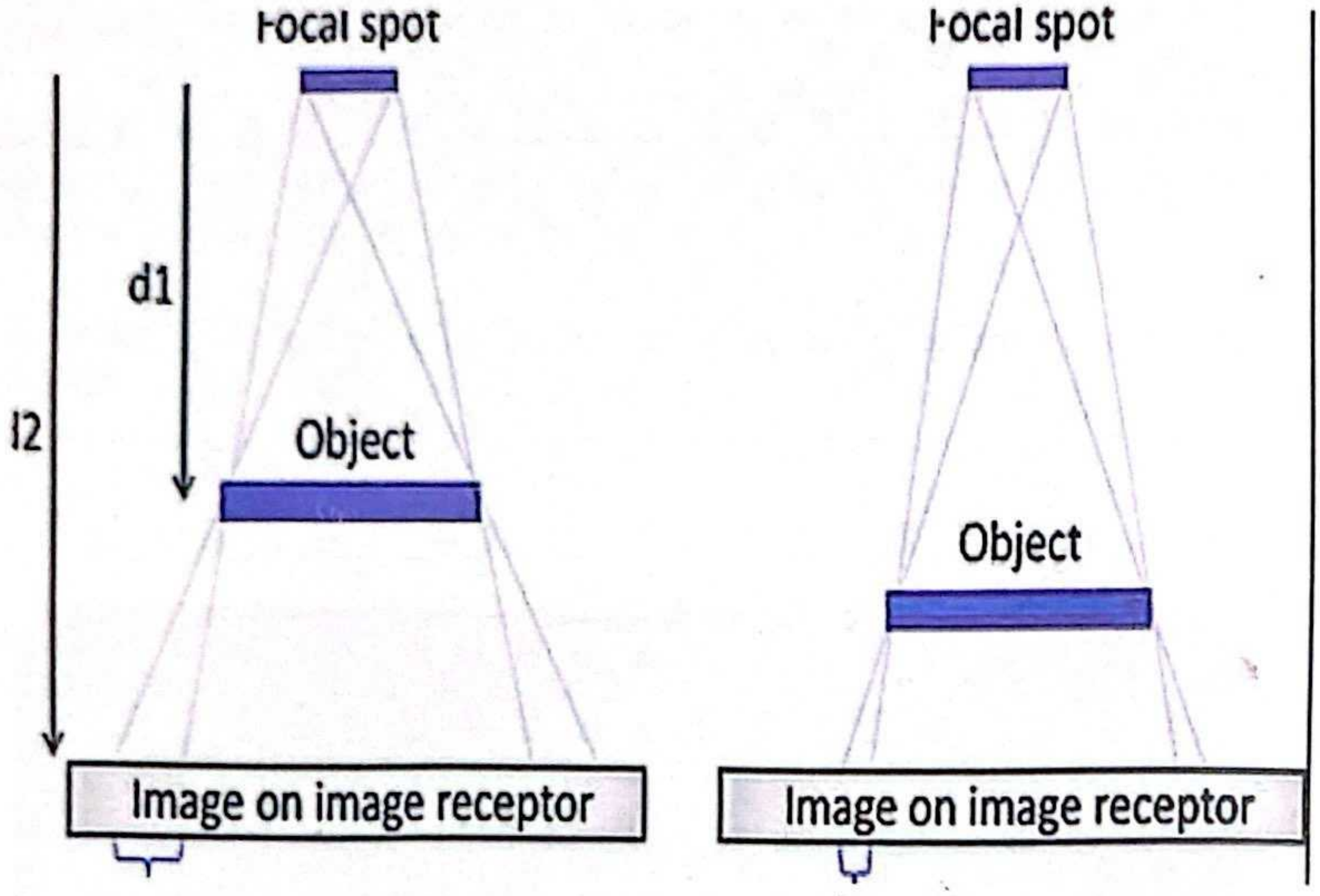
- figure of 3 sign: contour abnormality of the aorta
- inferior rib notching: Roesler sign
- Angiography: CTA/MRA/DSA
- Excision of coarctation and end-to-end anastomosis, balloon angioplasty. Subclavian flap repair





PHYSICS

Q.1) Identify? **(2017), (2016), (2018)**


Focal spot
d1
l2
Object
Image on image receptor
Focal spot
Object
Image on image receptor

FFD/FOD

SID/SOD

Definition:

For a given film to focal distance, greater the object to film distance, greater will be magnification.

Magnification=FFD/FOD

The formula for magnification is:

M=SID/SOD source to image receptor distance/source to object distance

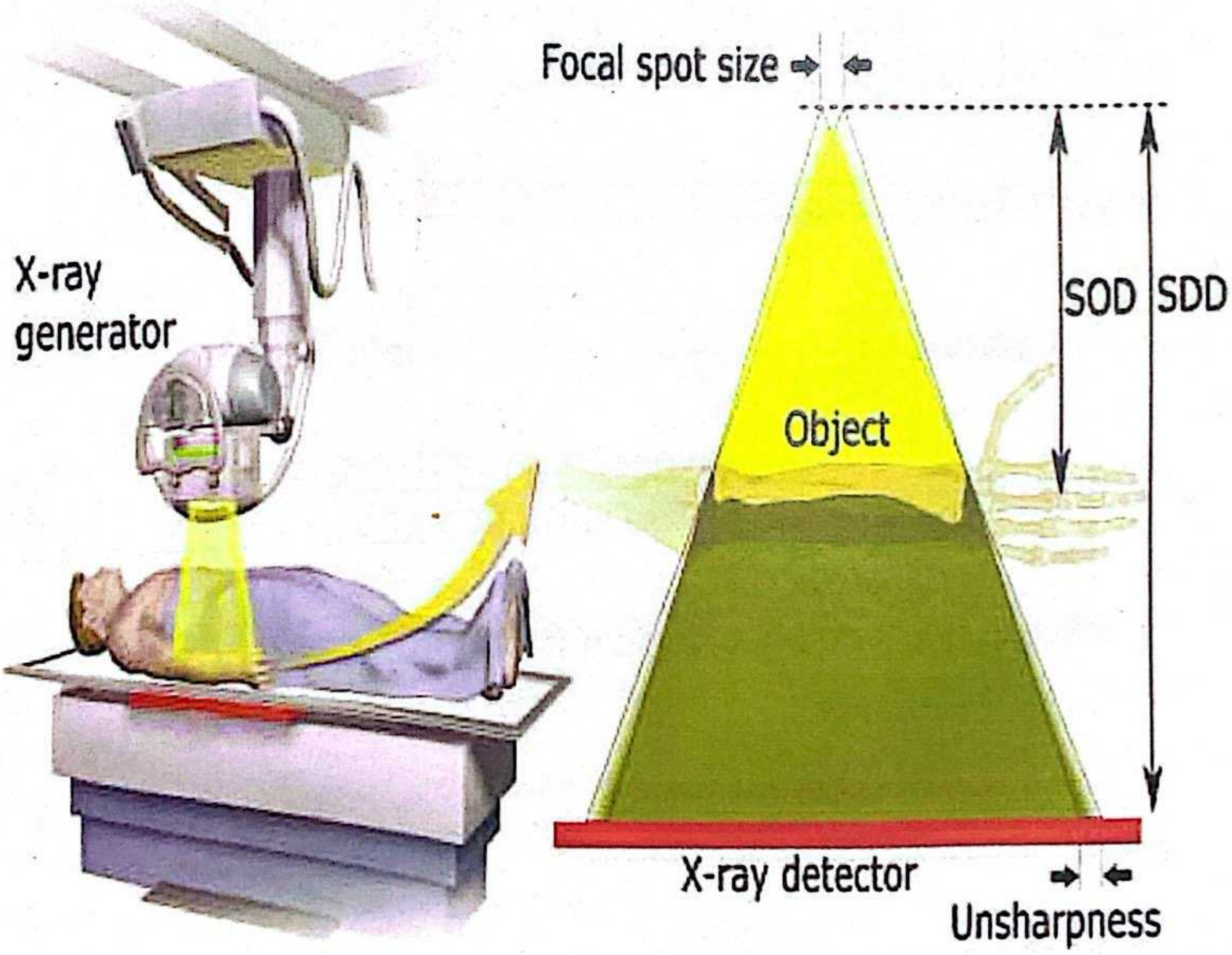
Uses of magnification:

1. Mammography
2. Conventional cerebral angiography

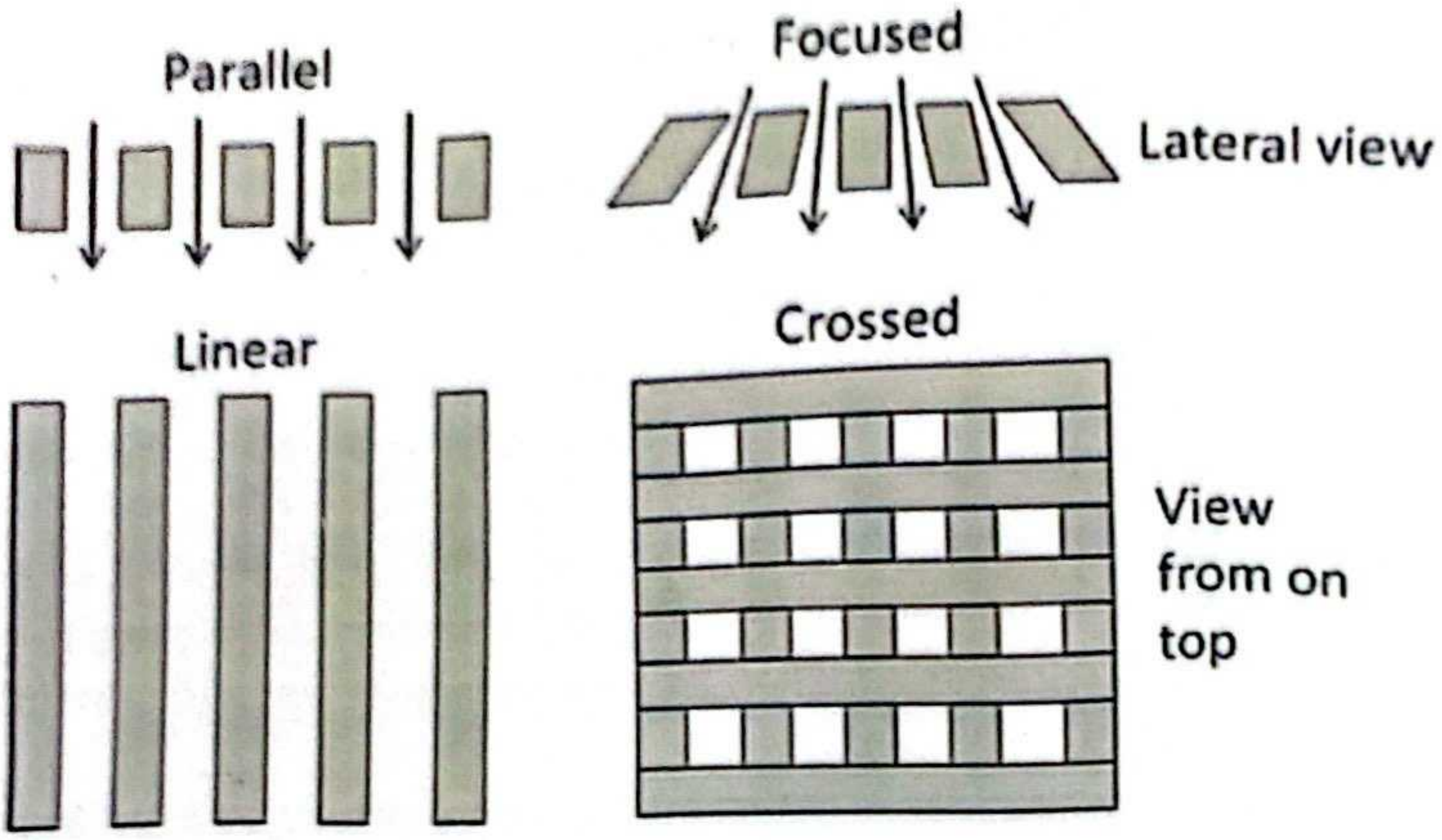
Disadvantages of magnification:

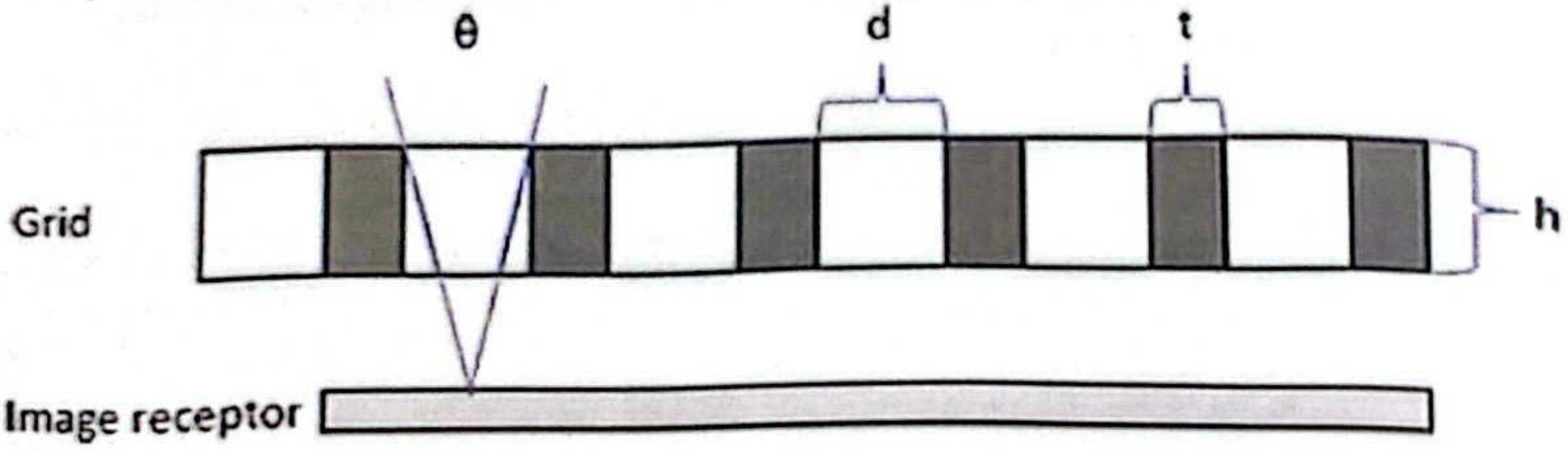
1. Decreased resolution
2. Increased patient Dose

- Magnification radiography is sometimes referred to as macroradiography.
- Usually, grids are not needed for magnified radiography.
- The large OID results in a significant air gap so that much of the scatter radiation misses the image receptor.
- With larger OID, less scatter radiation reaches the image receptor
- By changing the voltages of the intermediate electrodes, the electron crossover point (or focus can be moved nearer to the input screen so that the intensifier operates in a magnification mode.
- Magnification effectively reduces the nullification gain, there will be reduced brightness on the output screen. To restore brightness requires an increase in exposure factors, thus increasing the patient's skin dose.
- **Magnification is reduced by using a longer Film focal spot FFD or by decreasing the object-film distance FOD.**
- **M= FOD/FFD**



Q.2) Identify? (2017)


Parallel
Focused
Lateral view
Linear
Crossed
View from on top


θ
d
t
Grid
h
Image receptor

Grid ratio = $\frac{h}{d}$

Grid factor = $\frac{\text{Exposure necessary with a grid}}{\text{Exposure without a grid}}$

Proportion of direct radiation stopped = $\frac{t}{t + d}$

Θ = angle of acceptance of scatter

Anti-scatter grids

Grid ratio

This is the ratio of the thickness of the grid to the distance between the lead strips. The larger the grid ratio the smaller the angle of acceptance (θ) and the smaller the proportion of scatter that can pass through the grid.

Grid factor

This indicates the increase in exposure and, therefore, the increase in patient dose required to keep the dose to the image receptor the same as without a grid. This is determined by the design of the grid and the amount of scatter present in the x-ray beam.

Primary transmission

This is a measure of how much of the primary (as opposed to the scattered secondary) beam is stopped.

Grids are placed between the patient and the film-screen combination. The most commonly used grids are focused crossed grids. If a focused grid is placed the wrong way around it produces a linear artefact on the film with bands of very low exposure due to the orientation of the grid obstructing the photon beam.

Linear artifac

To avoid grid lines the grid is vibrated back and forth so that the lines are blurred out by the motion e.g. the Potter-Bucky grid.

Disadvantages

Increased dose to patient

Incorrect usage: when there is less tissue (e.g. paediatrics) the small kV used means the amount of scatter is small enough that the increased dose required by using a grid is not justified.

Alternatives

Instead of using an anti-scatter grid if dose increase is of concern one can use an air gap between the patient and the receptor. Increasing the distance between the patient and the film means scattered photons are more likely to miss the film due to their divergent paths and lower intensities.

Effect of grid ratio on grid factor?

The higher the grid ratio the higher the grid factor, the better the image contrast but at a cost of increased patient dose. Grid ratio of 8:1 is generally used for 70-90 kVp technique and 12:1 is used for >90 kVp technique.

Beam Restriction devices: Diaphragm, Collimators, Cones and Cylinders

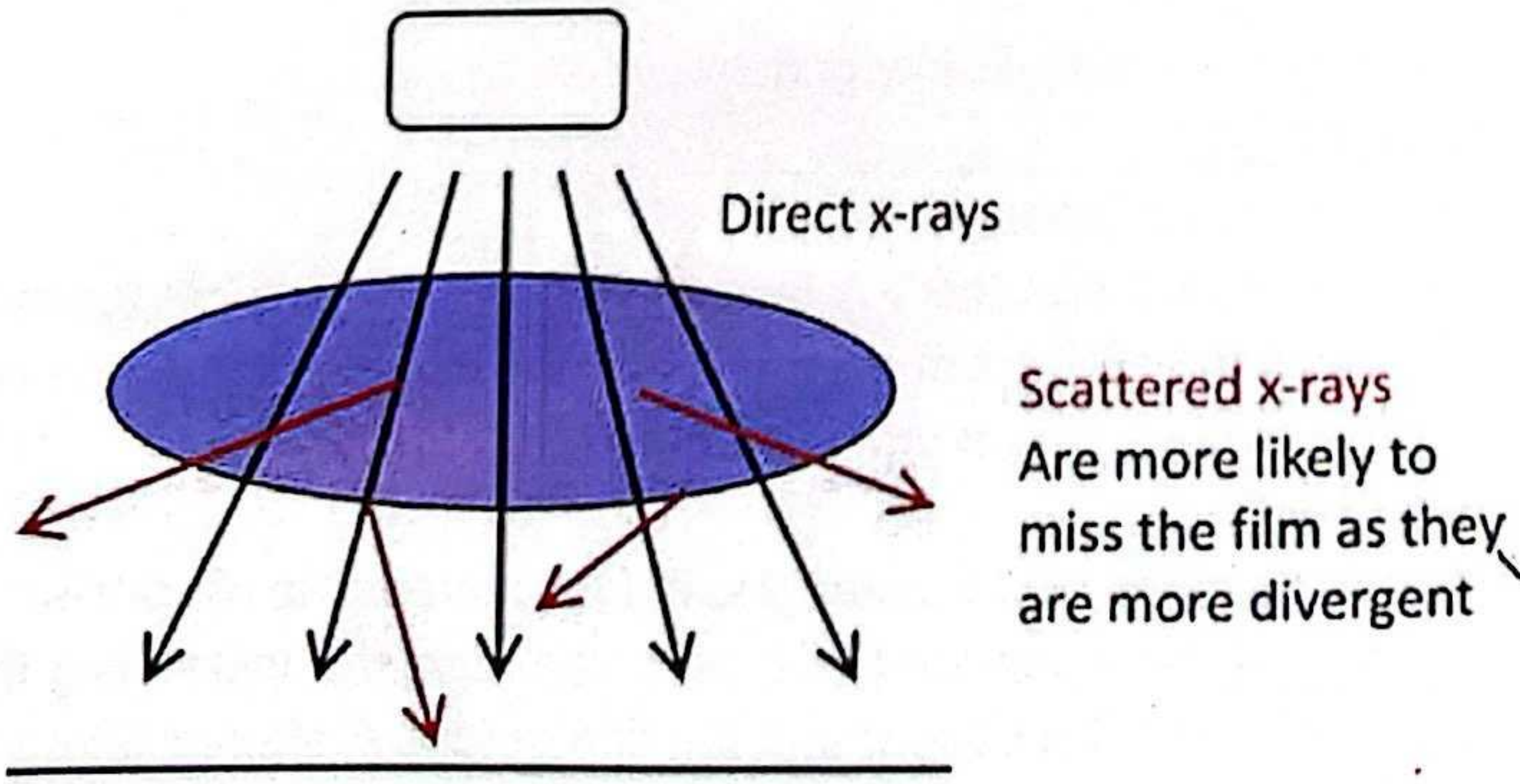
Types

1. focussed grids (most grids): strips are slightly angled so that they focus in space
2. parallel grid: used for short fields or long distances
3. moving grids (also known as Potter-Bucky grids): eliminates the fine grid lines that may appear on the image when focussed or parallel grids are used

Generally used where the anatomy is >10 cm:

- abdomen
- skull
- spine (except lateral cervical)
- contrast studies
- IVU
- RGU
- MCU
- barium studies (including lateral cervical)
- breast (mammography): uses 4:1 grid ratio

Air gap



Q.3) **(2017), (2015)**

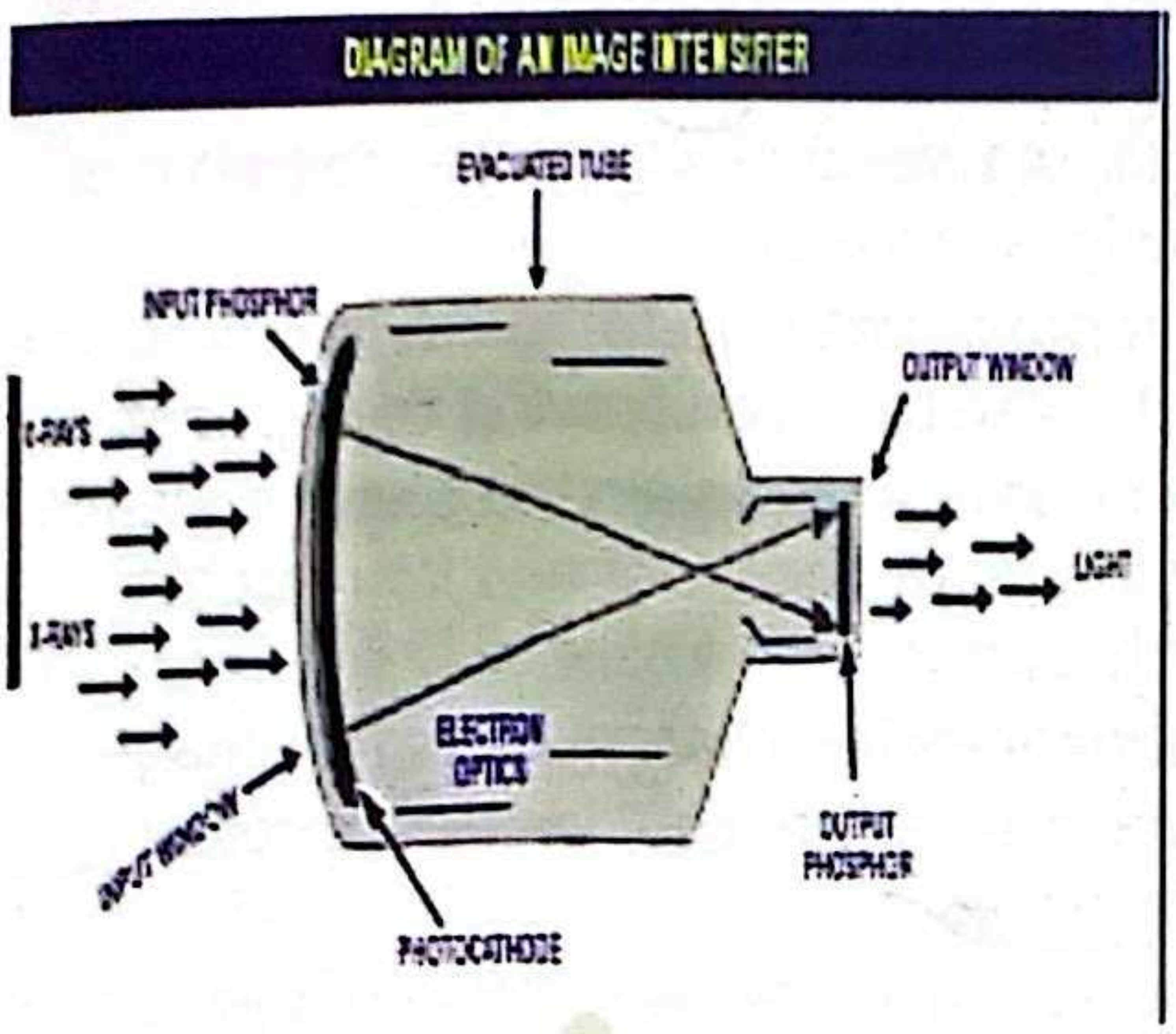


DIAGRAM OF AN IMAGE INTENSIFIER
EVACUATED TUBE
INPUT PHOSPHOR
X-RAYS
X-RAYS
OUTPUT WINDOW
LIGHT
ELECTRON OPTICS
INPUT WINDOW
OUTPUT PHOSPHOR
PHOTOCATHODE

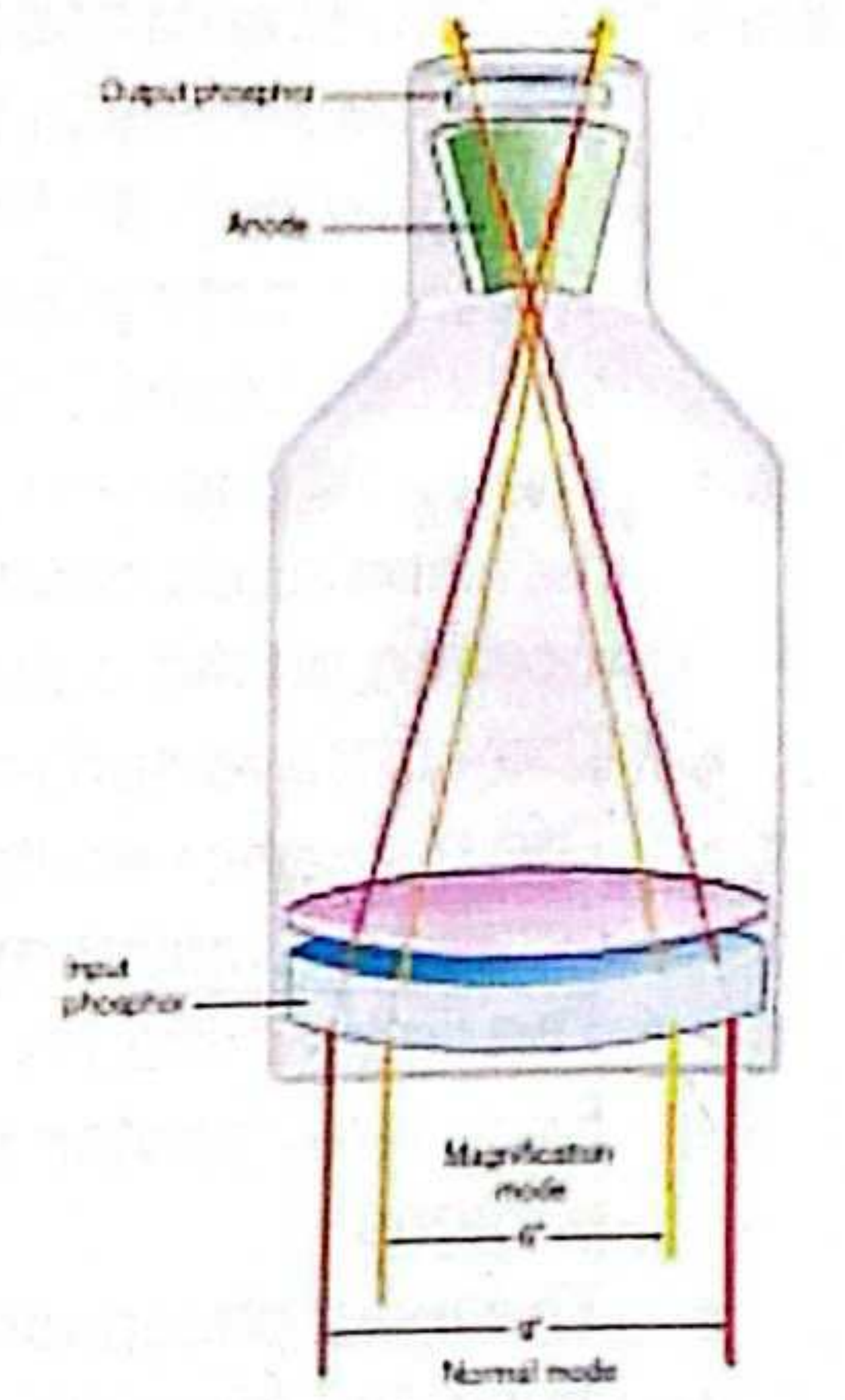

Output phosphor
Anode
Input phosphor
Magnification mode
6"
9"
Normal mode

Figure 13.4. Illustrates the image intensifier focusing for a normal and a magnified image.

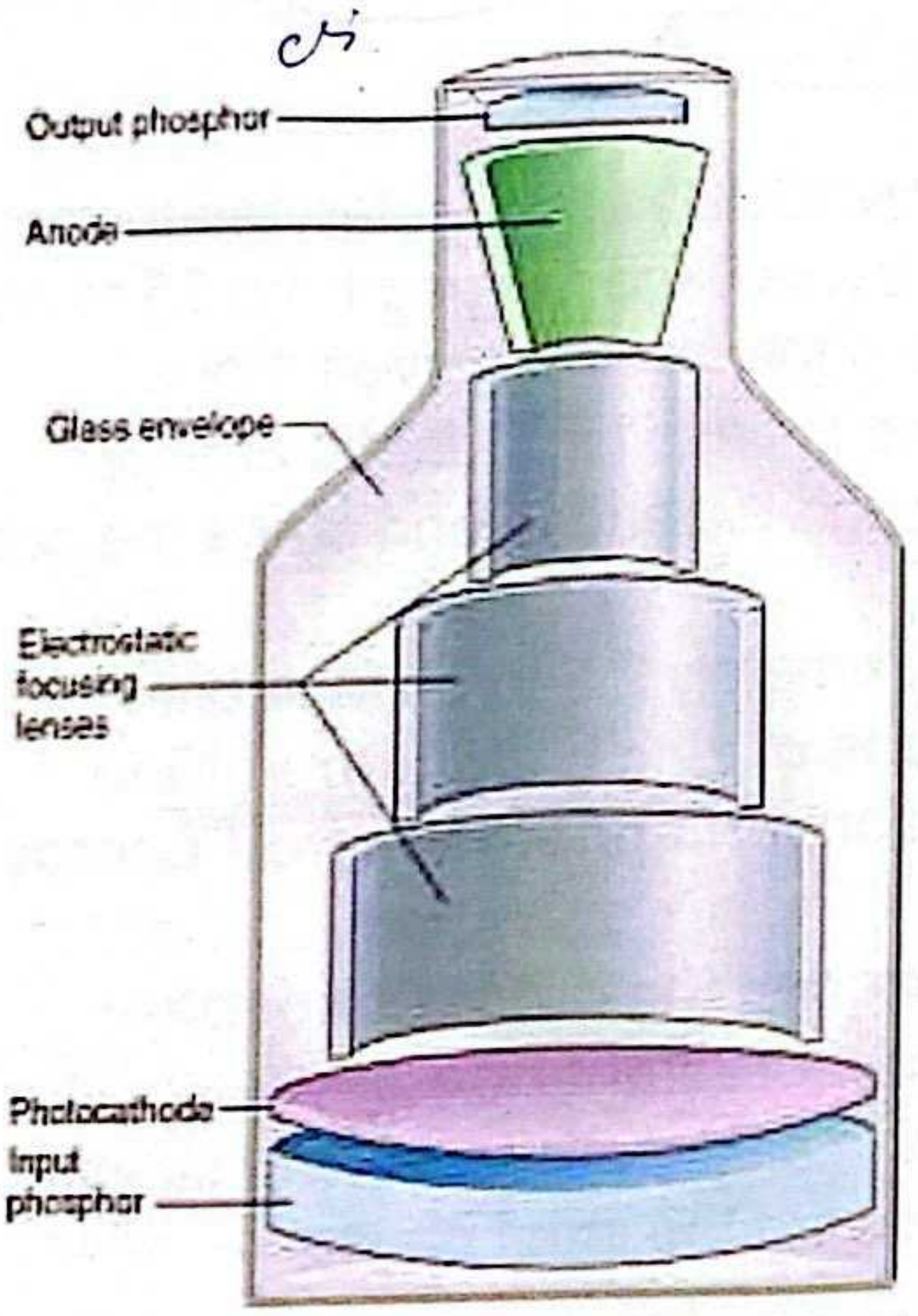

Output phosphor
Anode
Glass envelope
Electrostatic focusing lenses
Photocathode
Input phosphor

Figure 13.3. **Illustrates a cross-sectional view of a typical image intensifier tube.**

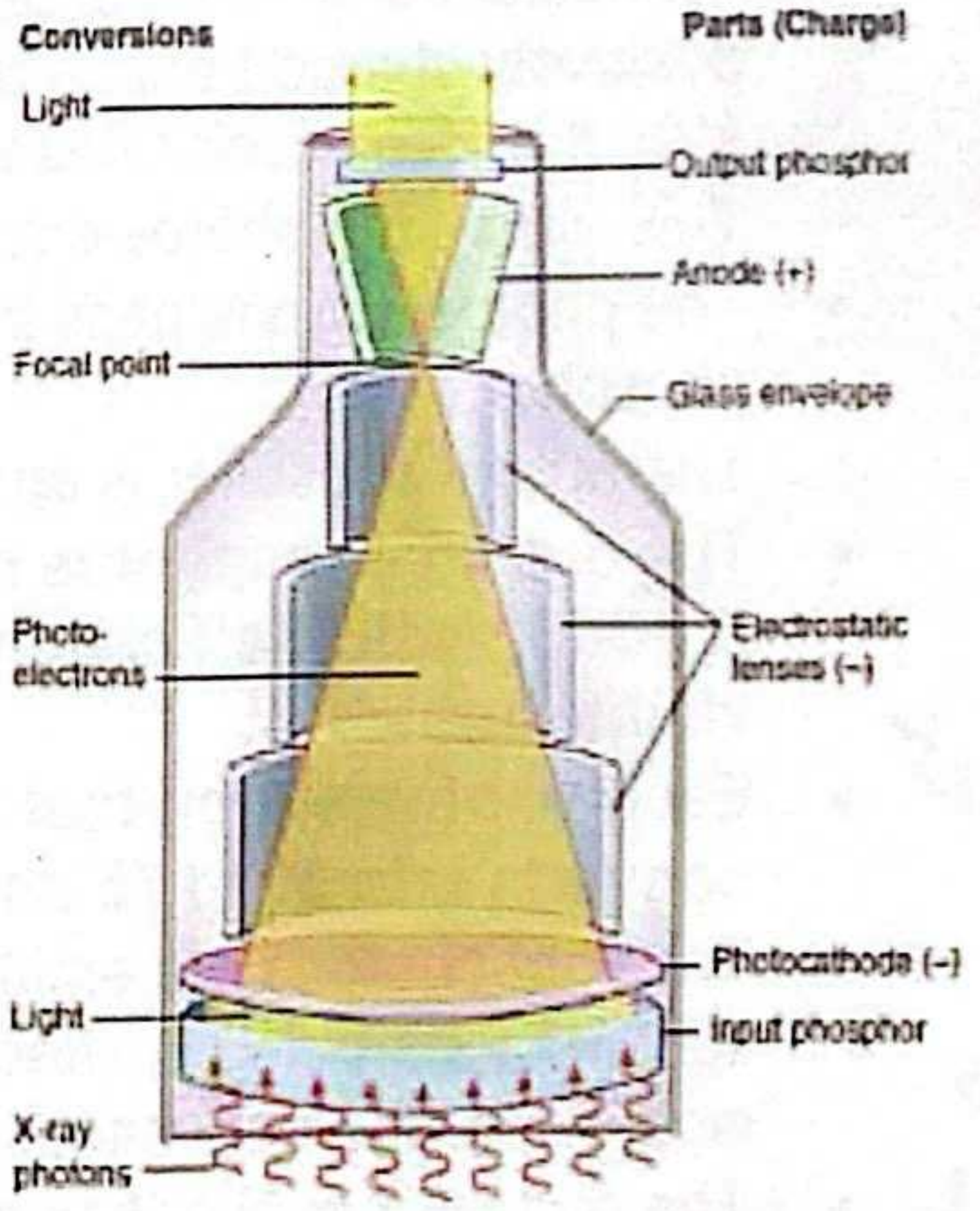

Conversions
Parts (Charge)
Light
Output phosphor
Anode (+)
Focal point
Glass envelope
Photo-electrons
Electrostatic lenses (−)
Photocathode (−)
Light
Input phosphor
X-ray photons

Figure 13.6. **Summarizes the components of the image intensifier and the process of converting remnant radiation with the latent image into light photons at the output phosphor. A thorough knowledge of these concepts is critical in understanding how an image intensifier works.**

CsI Cs

Input phosphor of the image intensifier tube is made of glass, titanium, steel, or aluminum and coated with cesium iodide (CsI) crystals because CsI has high x-ray photon absorption ① and light ② emission characteristics.

- The interactions in the input phosphor are similar to the interactions in an intensifying screen.
- The input phosphor is approximately 10 to 35 cm in diameter and absorbs about 60% of the exit radiation leaving the patient.
- The input phosphor is concave to maintain the same distance between each point on the input phosphor and its matching location on the output phosphor.
- The concave surface enhances the sharpness of the image.
- The phosphor emits light in a vertical line, which improves image detail and spatial resolution.
- The light emitted is proportional to the absorption of the photons.
- Each x-ray photon produces between 1,000 and 5,000 light photons.
- The input phosphor and photocathode are bonded together.
- The input phosphor is coated with a protective coating to prevent a chemical interaction with the photocathode materials.
- The photocathode is made of cesium and antimony which emit electrons when stimulated by light.

Output phosphor

- Photoelectrons from the photocathode are accelerated toward the positively charged anode by low voltage ranging from 25 to 35 kVp, this kVp accelerates the photoelectrons even more.
- This allows the photoelectrons to have high kinetic energy.
- The photoelectrons pass through the anode and strike the output phosphor.
- The output phosphor is approximately 2.5 to 5 cm in diameter.
- **The output phosphor is made of zinc cadmium sulfide (ZnCdS), which efficiently converts photoelectron energy into visible light.**
- **Each photoelectron that reaches the output phosphor converts into 50 to 75 times more light photons**
- The light photons are emitted in all directions which risks some light photons being emitted toward the input phosphor, which would degrade the image.
- The output phosphor has a thin aluminum coating that prevents the light photons from leaking back across the image intensifier, thereby decreasing the image noise and improving the resolution of the image

Effect of magnification gain:

- Better spatial resolution
- Better contrast resolution
- Higher patient dose

Q.4) **(2017)**

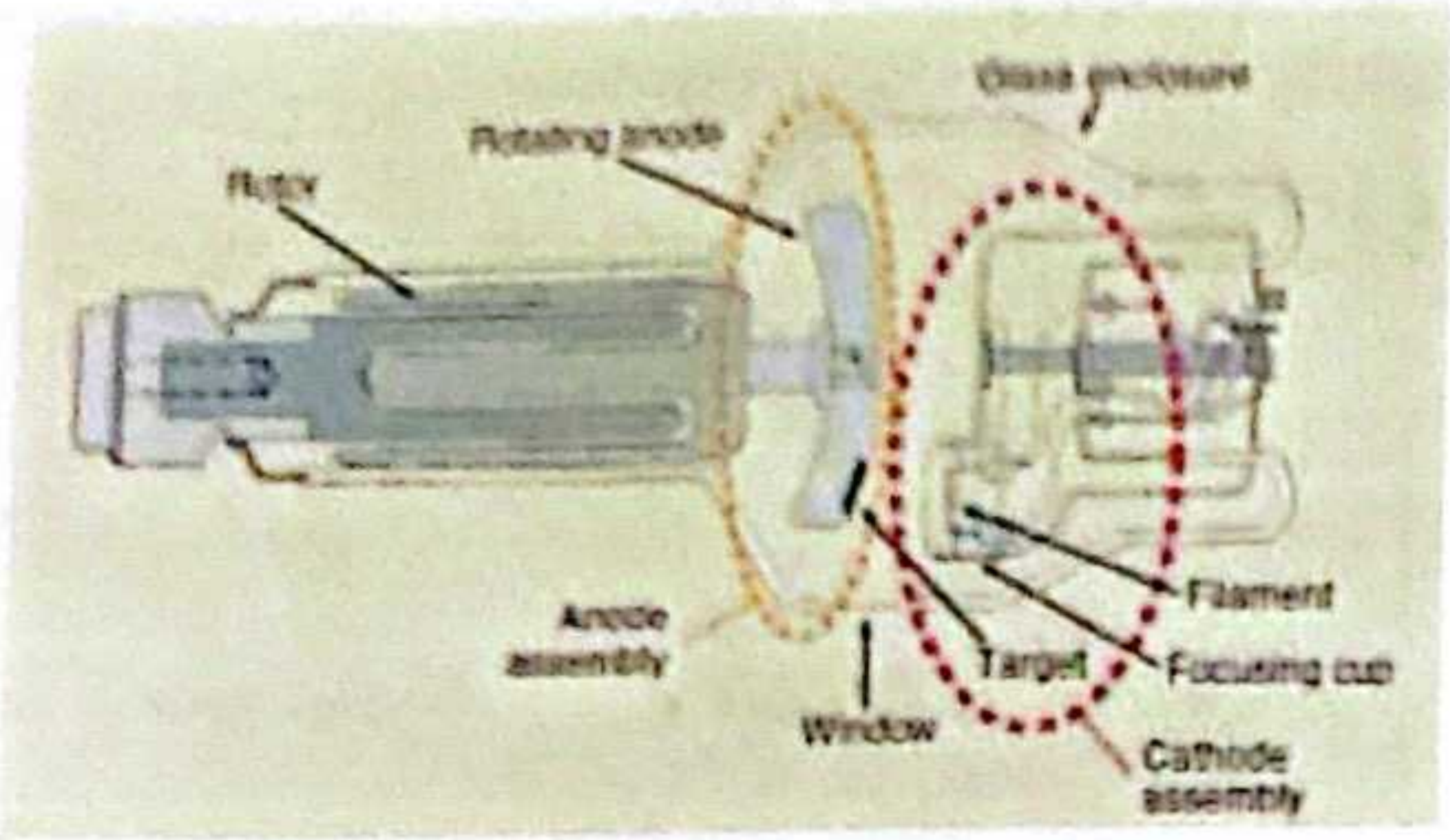

Glass enclosure
Rotating anode
Rotor
Anode assembly
Window
Target
Filament
Focusing cup
Cathode assembly

FIGURE 6-1 Principal parts of a rotating anode x-ray tube

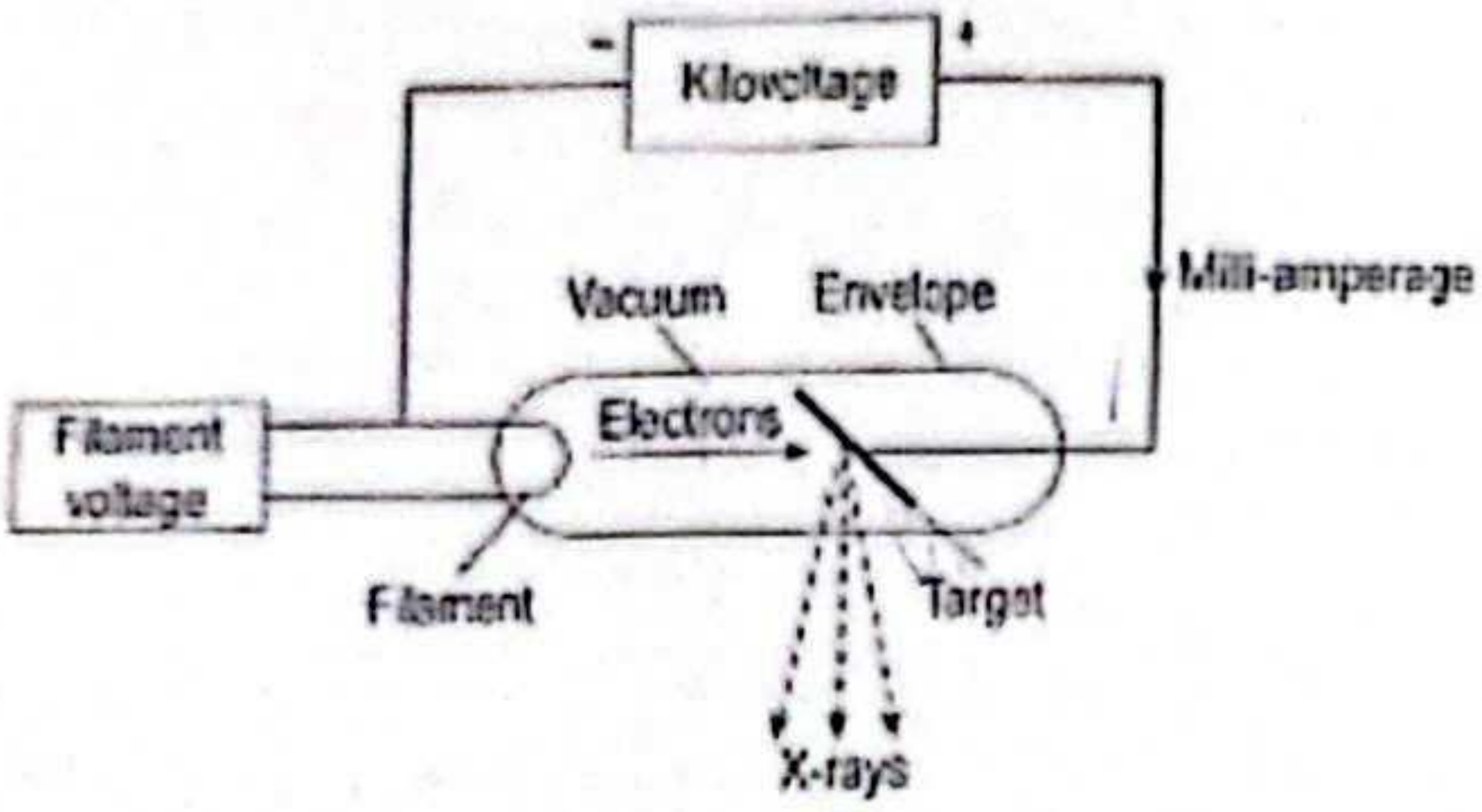

Kilovoltage
-
+
Milli-amperage
Vacuum
Envelope
Electrons
Filament voltage
Filament
Target
X-rays

Figure 1.4 An X-ray tube and its power supplies.

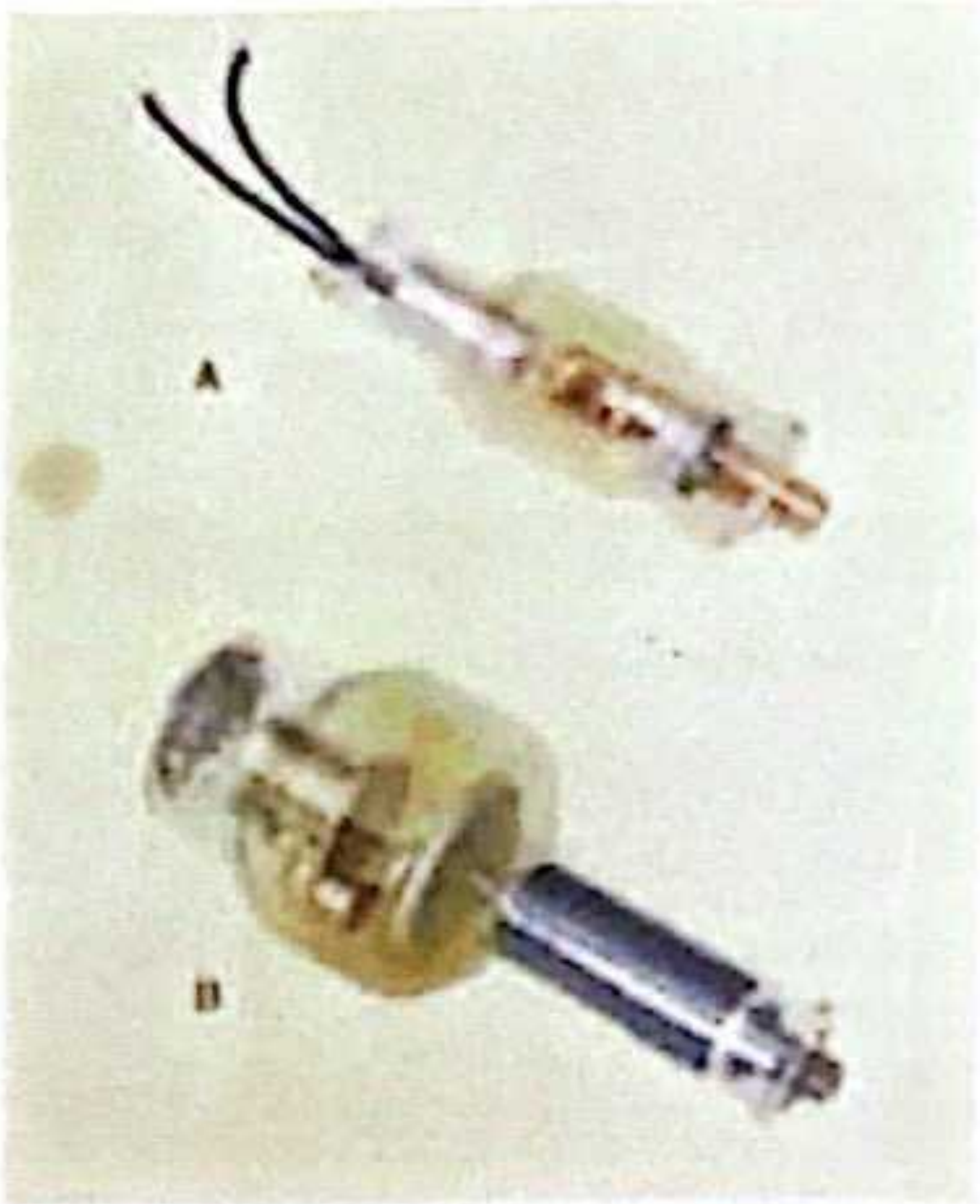


FIGURE 6-10 All diagnostic x-ray tubes can be classified according to the type of anode. A, Stationary anode. B, Rotating anode.

✓

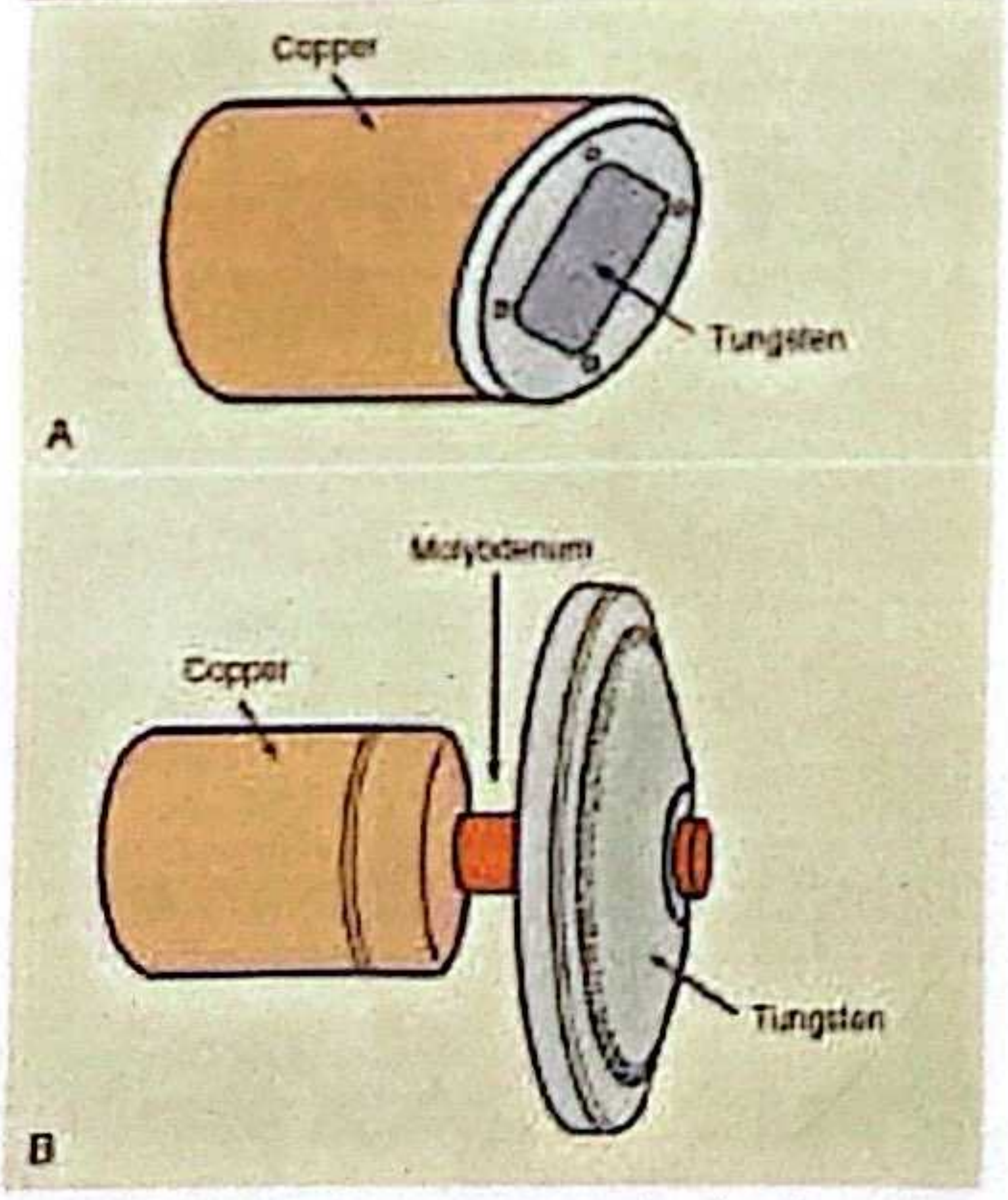

Copper
Tungsten
A
Molybdenum
Copper
Tungsten
B

FIGURE 6-11 **A,** In a stationary anode tube, the target is embedded in the anode. **B,** In a rotating anode tube, the target is the rotating disc.

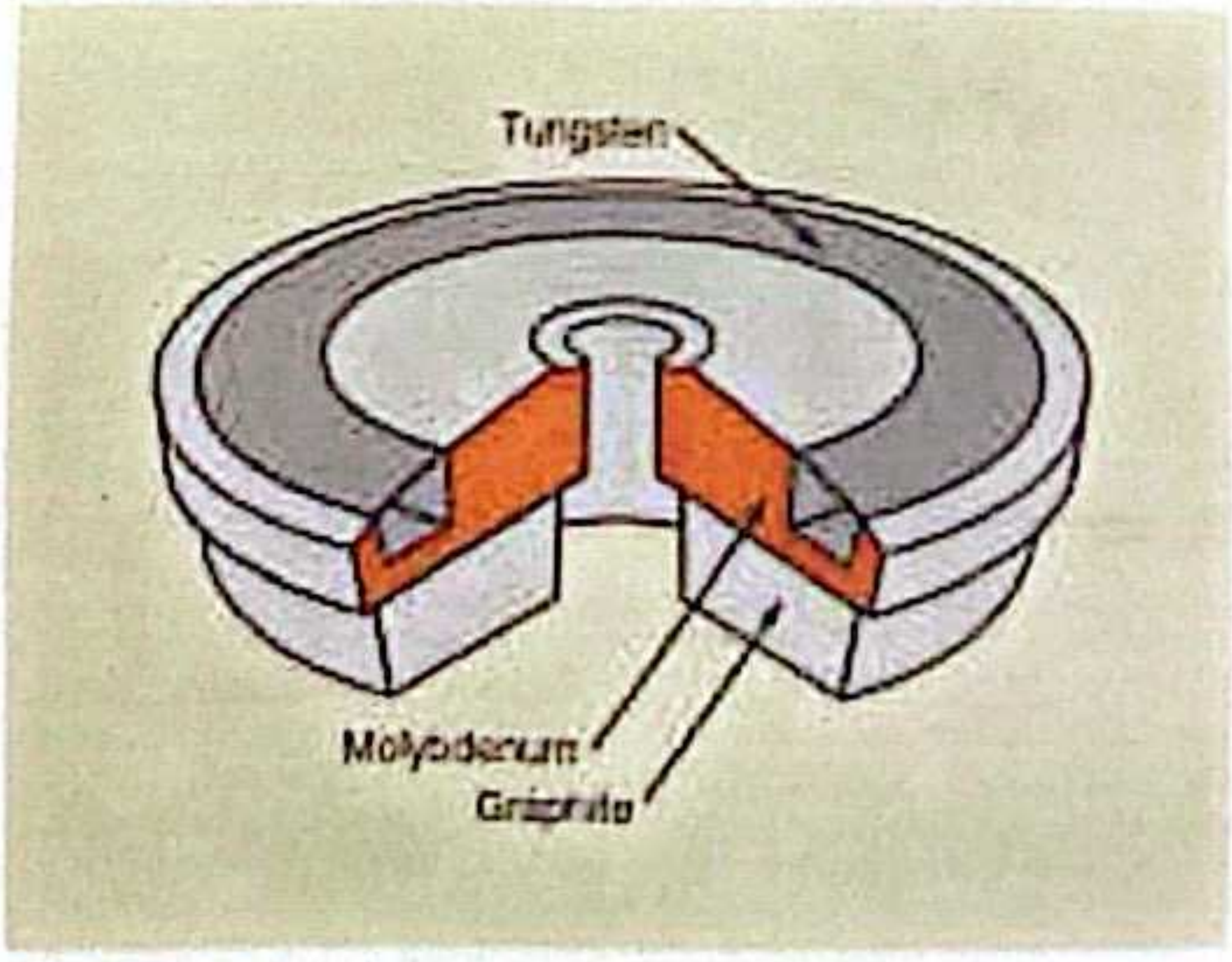

Tungsten
Molybdenum
Graphite

FIGURE 6-12 A layered anode consists of a target surface backed by one or more layers to increase heat capacity.

- The rotating anode x-ray tube allows the electron beam to interact with a much larger target area therefore, the heating of the anode is not confined to one small spot, as in a stationary anode tube.
- Thus, the rotating anode tube provides nearly 500 times more area to interact with the electron beam than is provided by a stationary anode tube.
- Heat capacity can be further improved by increasing the speed of anode rotation.
- Most rotating anodes revolve at 3400 rpm (revolutions per minute).
- The anodes of high-capacity x-ray tubes rotate at 10,000 rpm.
- The stem of the anode is the shaft between the anode and the rotor.
- It is narrow so as to reduce its thermal conductivity.
- The stem usually is made of molybdenum because it is a poor heat conductor.
- Occasionally, the rotor mechanism of a rotating anode tube fails.
- When this happens, the anode becomes overheated and pits or cracks, causing tube failure
- Bearing damage is a major cause of tube failure
- Tungsten is the material of choice for the target for general radiography for three main reasons:

1. **Atomic number**—Tungsten's high atomic number, 74, results in high-efficiency x-ray production and in high-energy x-rays.
2. **Thermal conductivity**—Tungsten has a thermal conductivity nearly equal to that of copper. It is therefore an efficient metal for dissipating the heat produced.
3. **High melting point**—Any material, if heated sufficiently, will melt and become liquid. Tungsten has a high melting point (3400°C compared with 1100°C for copper) and therefore can stand up under high tube current without pitting or bubbling.

- K X-ray Energy (keV): 69-70 Kev

- An anode disk T, 7–10cm or more in diameter, usually made of molybdenum because of its high melting point and (relative to tungsten) its low density. An alternative material is graphite.
- The target annulus set in the bevelled edge of the anode. The target is usually an alloy of tungsten and rhenium, which has better thermal characteristics than pure tungsten and does not roughen with use as quickly.
- A thin molybdenum stem, M.
- A blackened copper rotor, R.

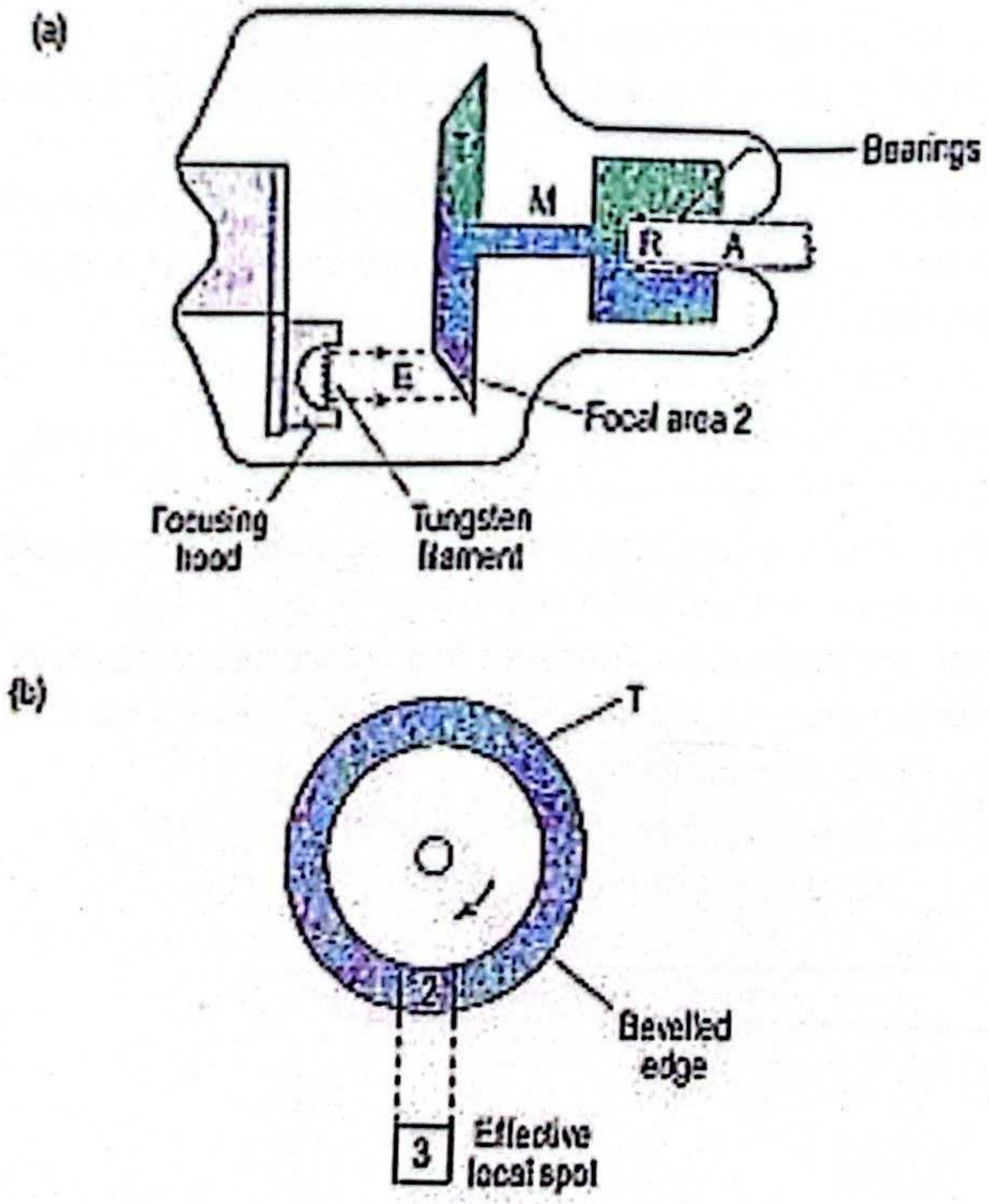

(a)
Bearings
T
M
R
A
E
Focal area 2
Focusing hood
Tungsten filament
(b)
T
2
Bevelled edge
3
Effective focal spot

Figure 3.14 The rotating anode X-ray tube.

Q.5) **(2015)**

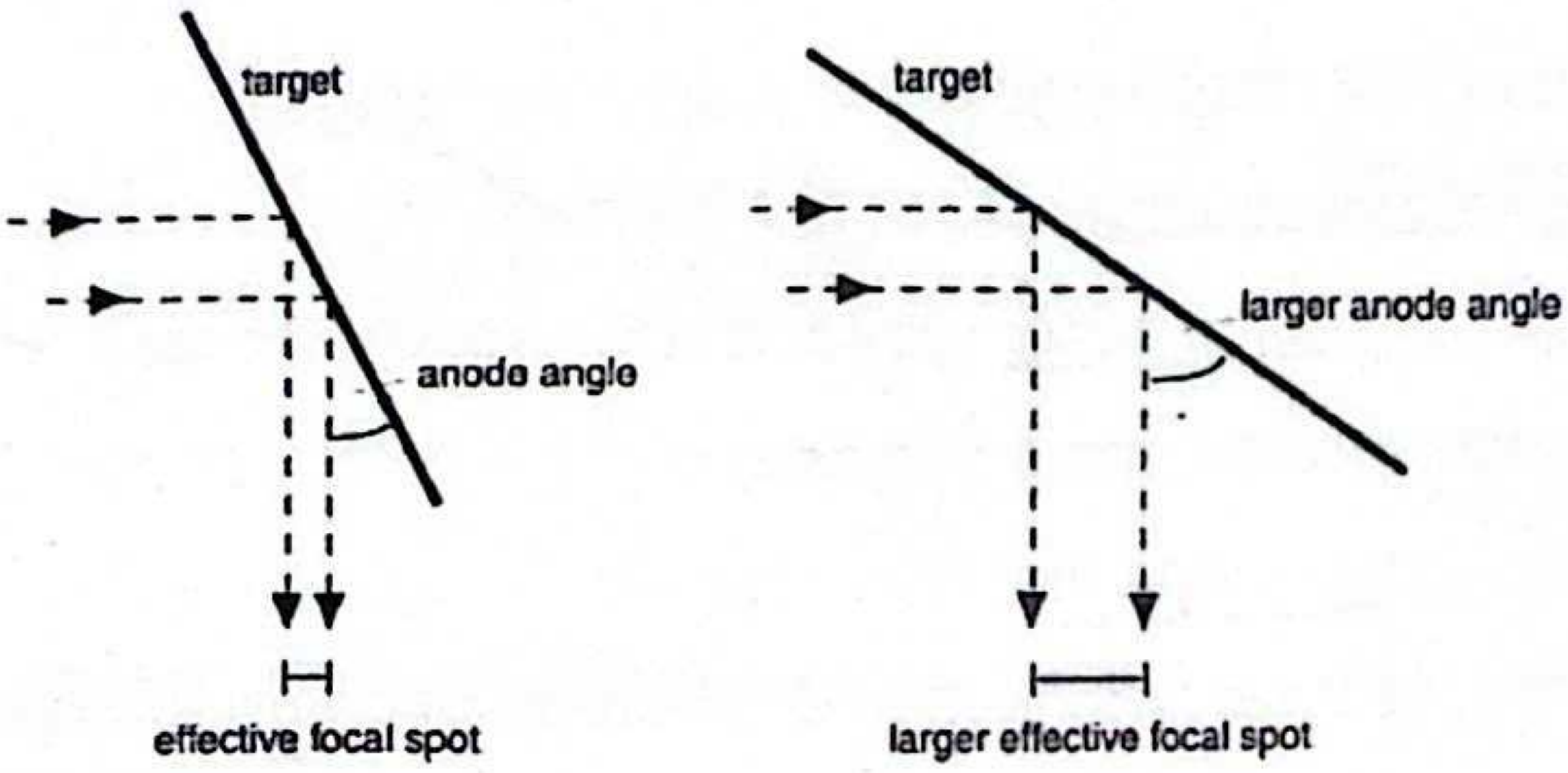

target
anode angle
effective focal spot
target
larger anode angle
larger effective focal spot

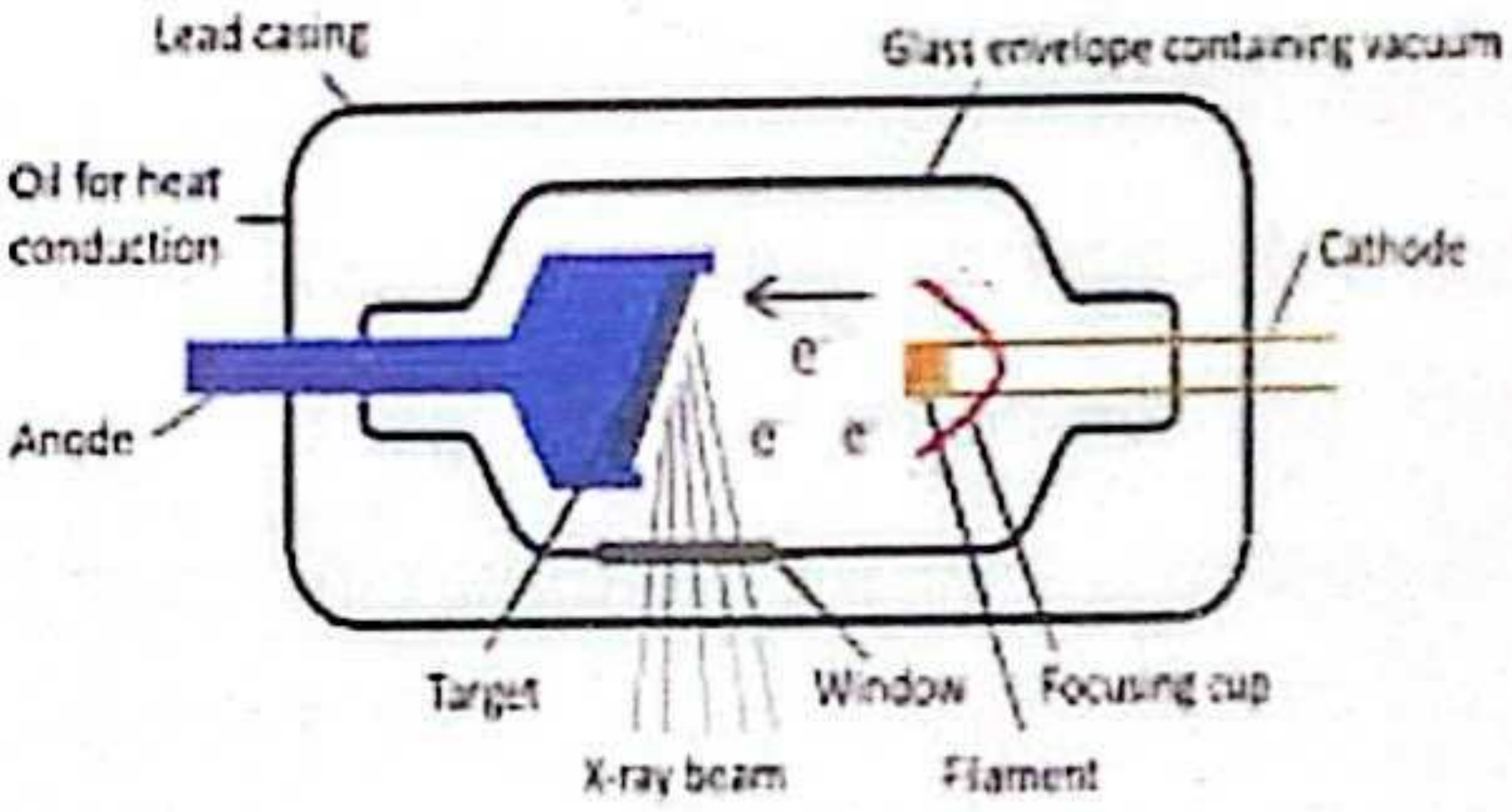
Figure 4.4 Anode angle

Material of anode in x-ray and mammography?

- XRay: Tungsten
- Mammography: Molybdenum

Different anode materials?

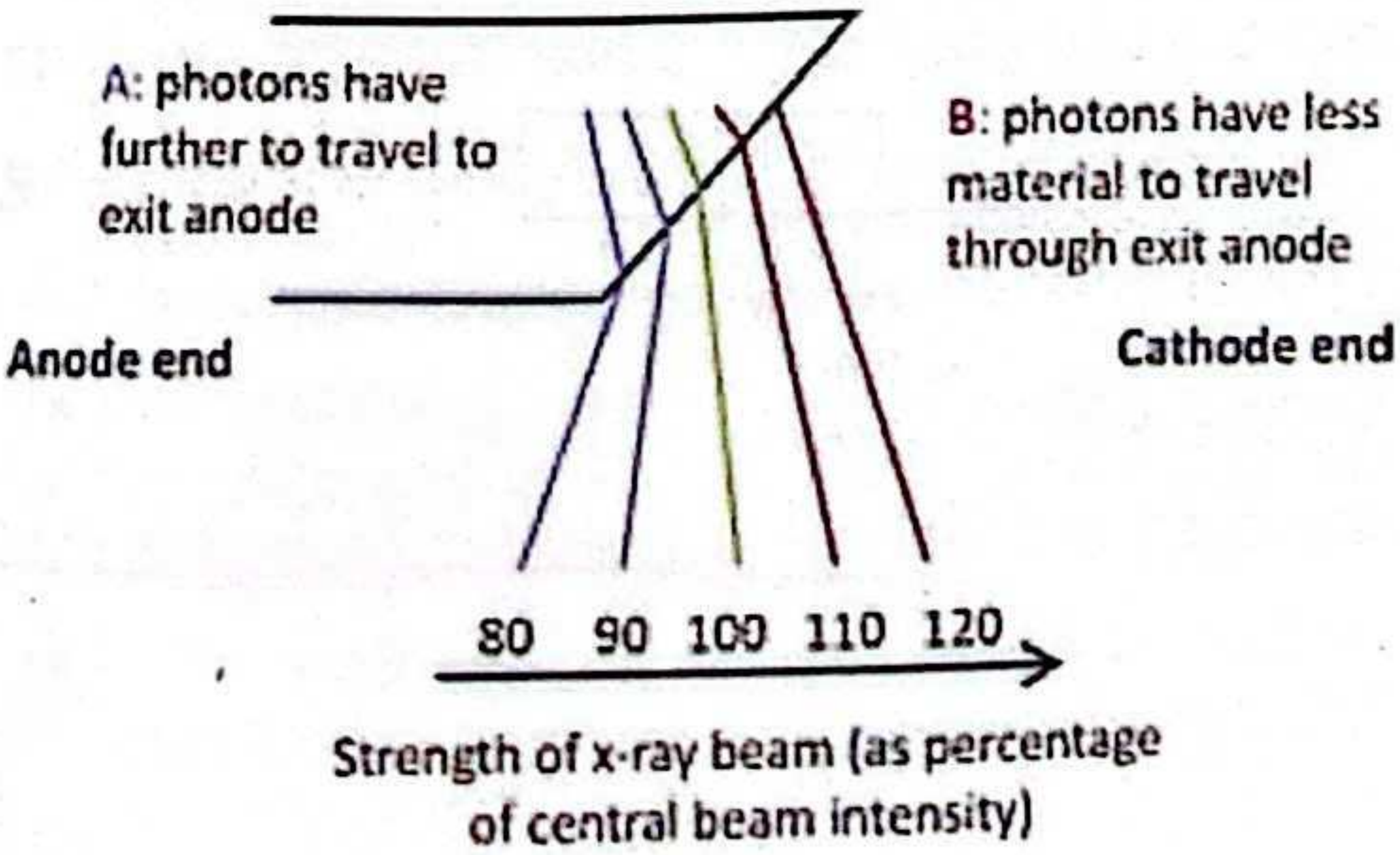
1. Tungsten
2. Molybdenum
3. Rhodium


Lead casing
Glass envelope containing vacuum
Oil for heat conduction
Cathode
Anode
e
e
e
Target
X-ray beam
Window
Focusing cup
Filament

Heel effect: Define?

An x-ray beam gets attenuated on the way out by the target material itself causing a decrease in intensity gradually from the cathode to anode direction as there is more of the target material to travel through. Therefore, the cathode side should be placed over the area of greatest density as this is the side with the most penetrating beam. Decreasing the anode angle gives a smaller effective focal spot size, which is useful in imaging, but a larger anode heel effect. This results in a less uniform and more attenuated beam.

** smaller angle = smaller focal spot size but larger anode heel effect **


A: photons have further to travel to exit anode
B: photons have less material to travel through exit anode
Anode end
Cathode end
80
90
100
110
120
Strength of x-ray beam (as percentage of central beam intensity)

Cathode

Filament

- Made of thin (0.2 mm) tungsten wire because tungsten:

o has a high atomic number (A 184, Z 74)

o is a good thermionic emitter (good at emitting electrons)

o can be manufactured into a thin wire

o has a very high boiling point (3370°c)

- Some cathodes have two filaments for broad and fine focusing

Focusing cup

- Made of molybdenum as:

o high melting point

o poor thermionic emitter so electrons aren't released to interfere with electron beam from filament

- Negatively charged to repel electrons towards the anode

Anode

- Target made of tungsten for same reasons as for filament
- Rhenium added to tungsten to prevent cracking of anode at high temperatures and usage
- Set into an anode disk of molybdenum with stem
- Positively charged to attract electrons
- Set at angle to direct x-ray photon beam down towards patient. Usual angle is 5° - 15°

Definitions

- **Target, focus, focal point, focal spot**: where electrons hit the anode
- **Actual focal spot**: physical area of the focal track that is impacted
- **Focal track:** portion of the anode where the electrons bombard. On a rotating anode this is a circular path
- **Effective focal spot:** the area of the focal spot that is projected out of a tube

Q.6) **(2017)**

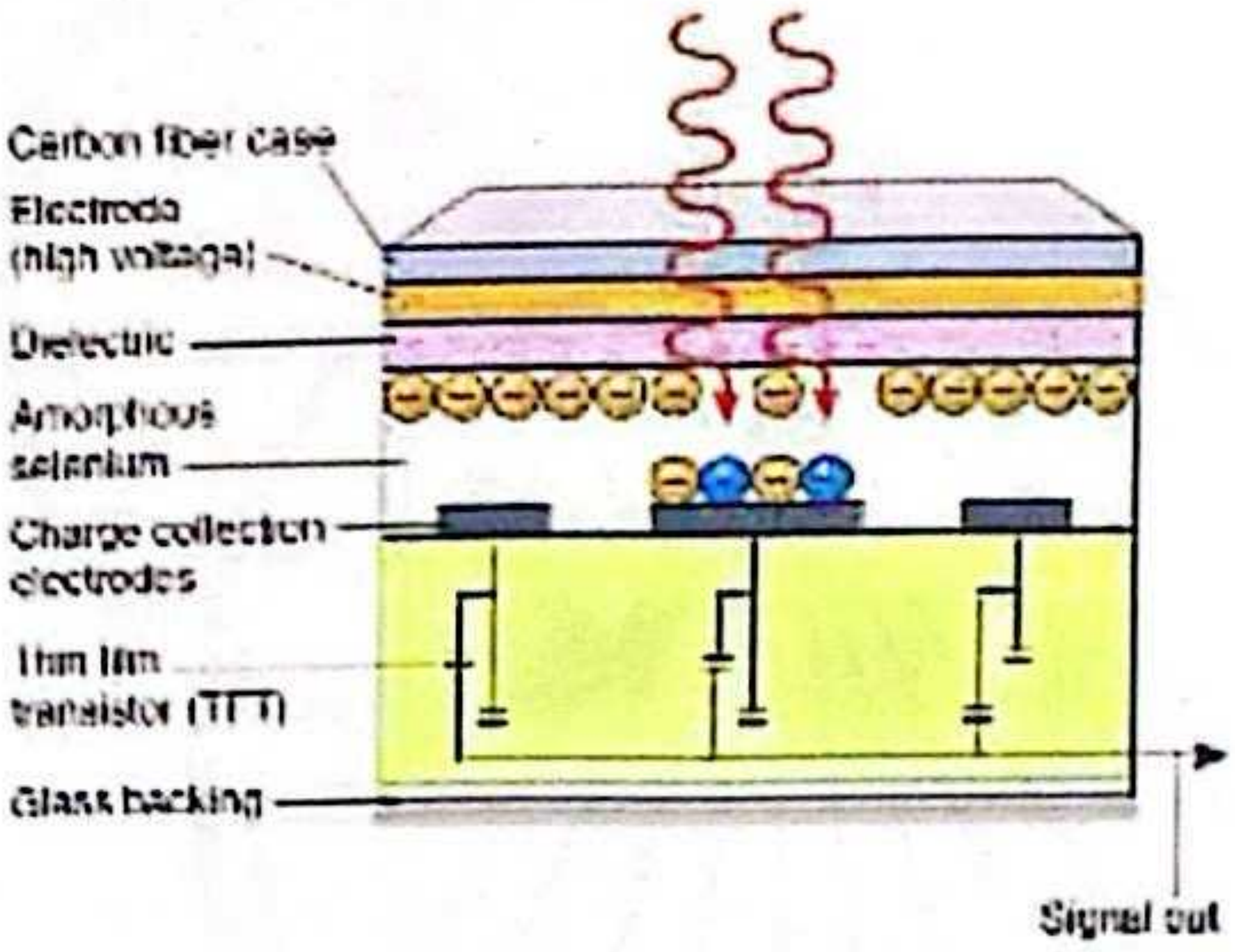
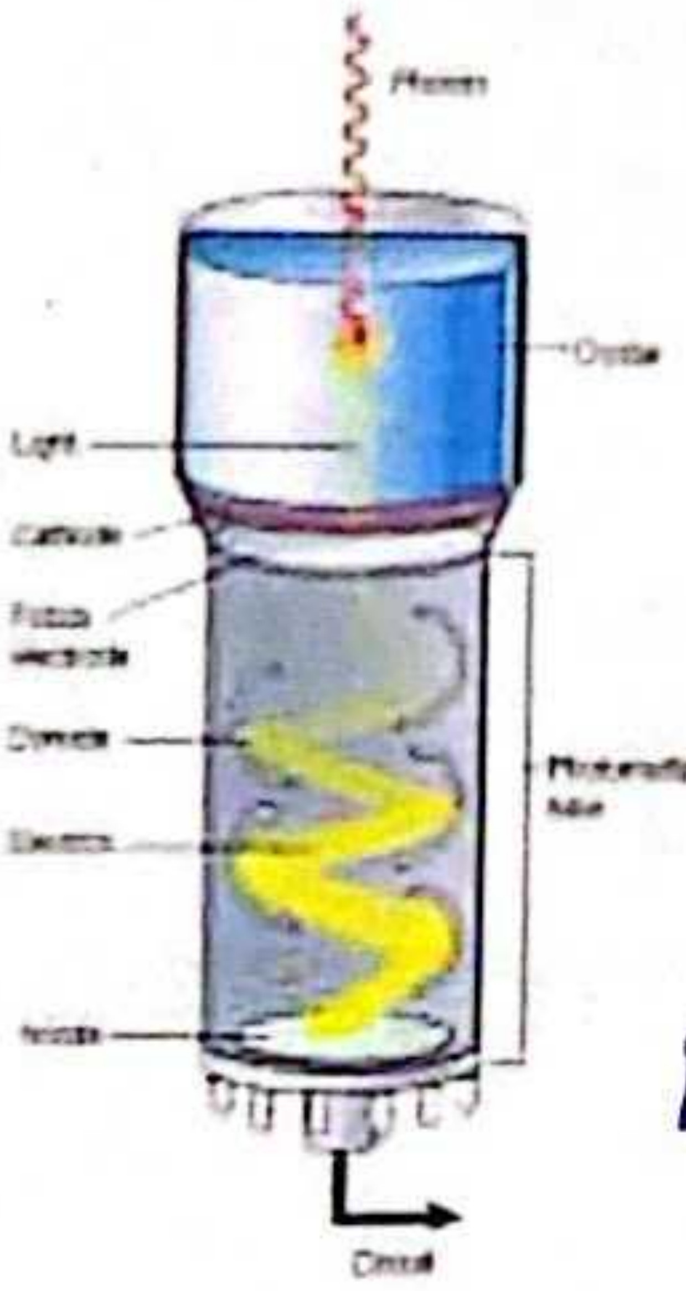

Carbon fiber case
Electrode (high voltage)
Dielectric
Amorphous selenium
Charge collection electrodes
Thin film transistor (TFT)
Glass backing
Signal out

Figure 14.12. Flat panel detector with direct conversion amorphous selenium.

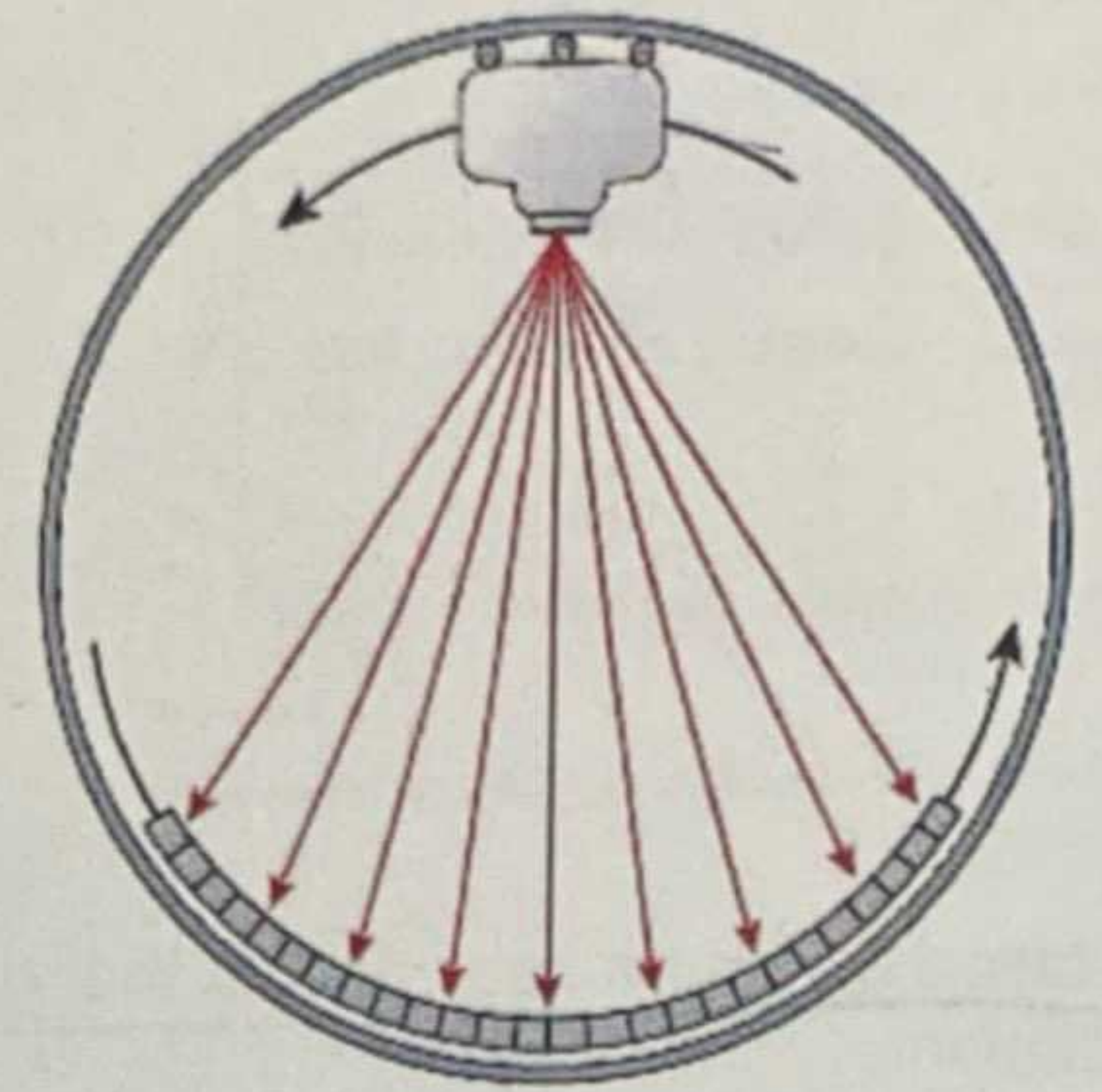

Photon
Crystal
Light
Cathode

L — ε

- Scintillation detectors use crystals that give off light when struck by radiation.
- The amount of light depends on the radiation energy deposited in the crystal.
- Higher radiation energy deposited results in greater light emission.
- The light emitted by the crystal is detected by a photomultiplier tube, which converts the light output into an electrical output signal, which is then measured.
- **Scintillators are used as detectors in CT scanners and nuclear medicine gamma cameras**
- **Most widely used scintillation phosphors are the inorganic crystals—thallium-activated sodium iodide (NaI : Tl) and thallium-activated cesium iodide (CsI : Tl).**
- **High sensitivity means that an instrument can detect very low radiation intensities.**
- **They are capable of measuring radiation intensities as low as single-photon interactions.**
- This property of scintillation detectors results in their **use as portable radiation devices** in much the same manner as Geiger counters are used.
- A portable scintillation detector is more sensitive than a Geiger counter because it has much higher detection efficiency.
- **For this application, the scintillation detector would be used to monitor the presence of contamination and perhaps low levels of radiation.**
- **Scintillation detectors are comprised by sodium iodide crystals that give off a flash of light when an x-ray photon is absorbed by the crystal.**
- **The current crystal of choice is cadmium tungstate which has 90% efficiency but minimal afterglow.**

Q.7 **(2017)**

3rd Generation CT


Rotating detector system

igure 17.4. Third-generation CT scanner.

1. Third-generation scanners use a wider fan-shaped beam
2. A curved array of 250 to 750 detectors which rotate 360 degrees within the gantry.
3. For the first time, the detectors and x-ray tube had the ability to continuously rotate.
4. The translate-rotate mechanism was replaced with this rotate-rotate mechanism.
5. The x-ray tube and detectors both rotate in a circle around the patient.
6. Problem with detector stability, and this was made worse by the movement of the gantry.
7. With the advent of multi slice scanners, the rotate-rotate geometry of the third-generation scanner has become an industry standard

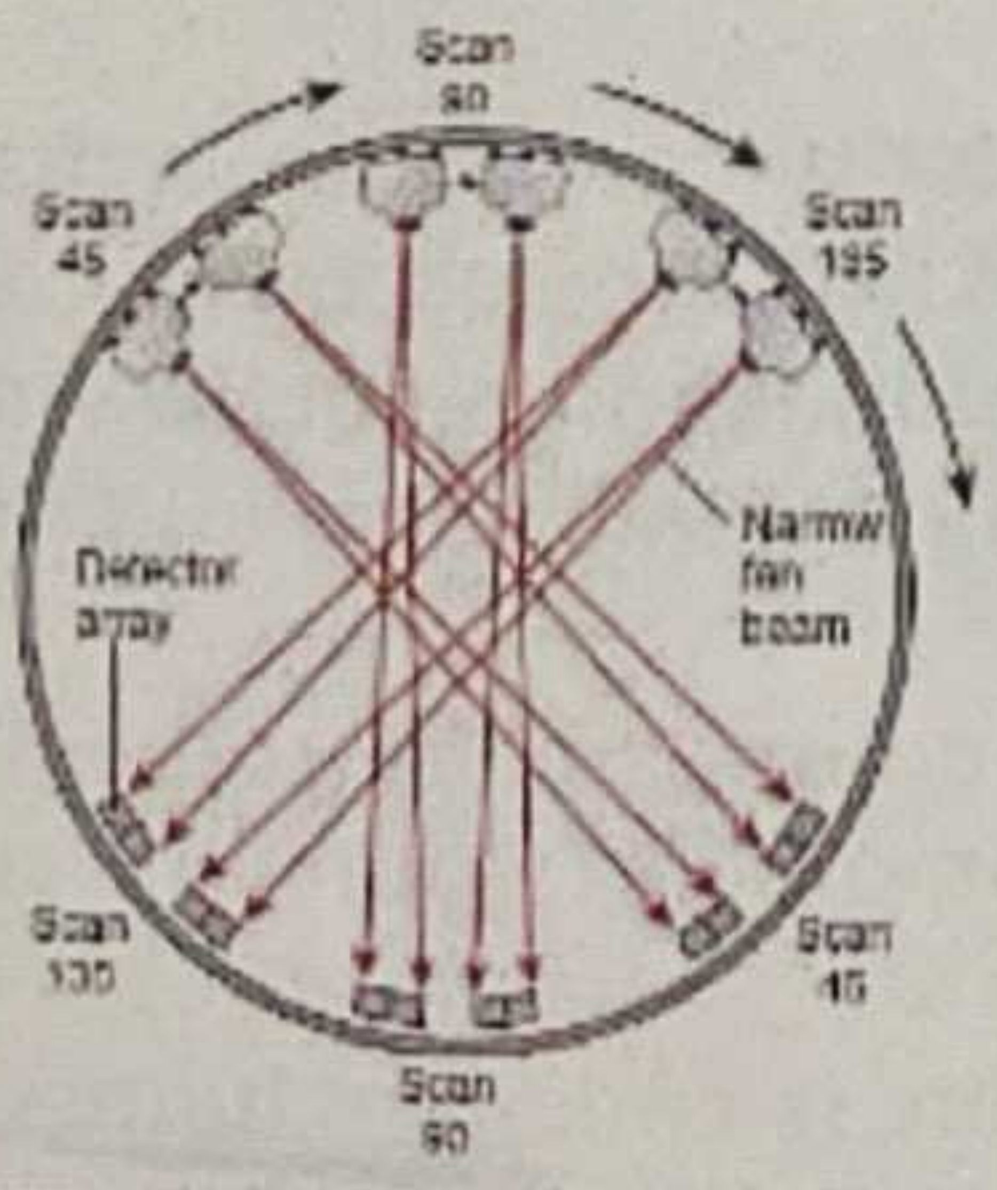
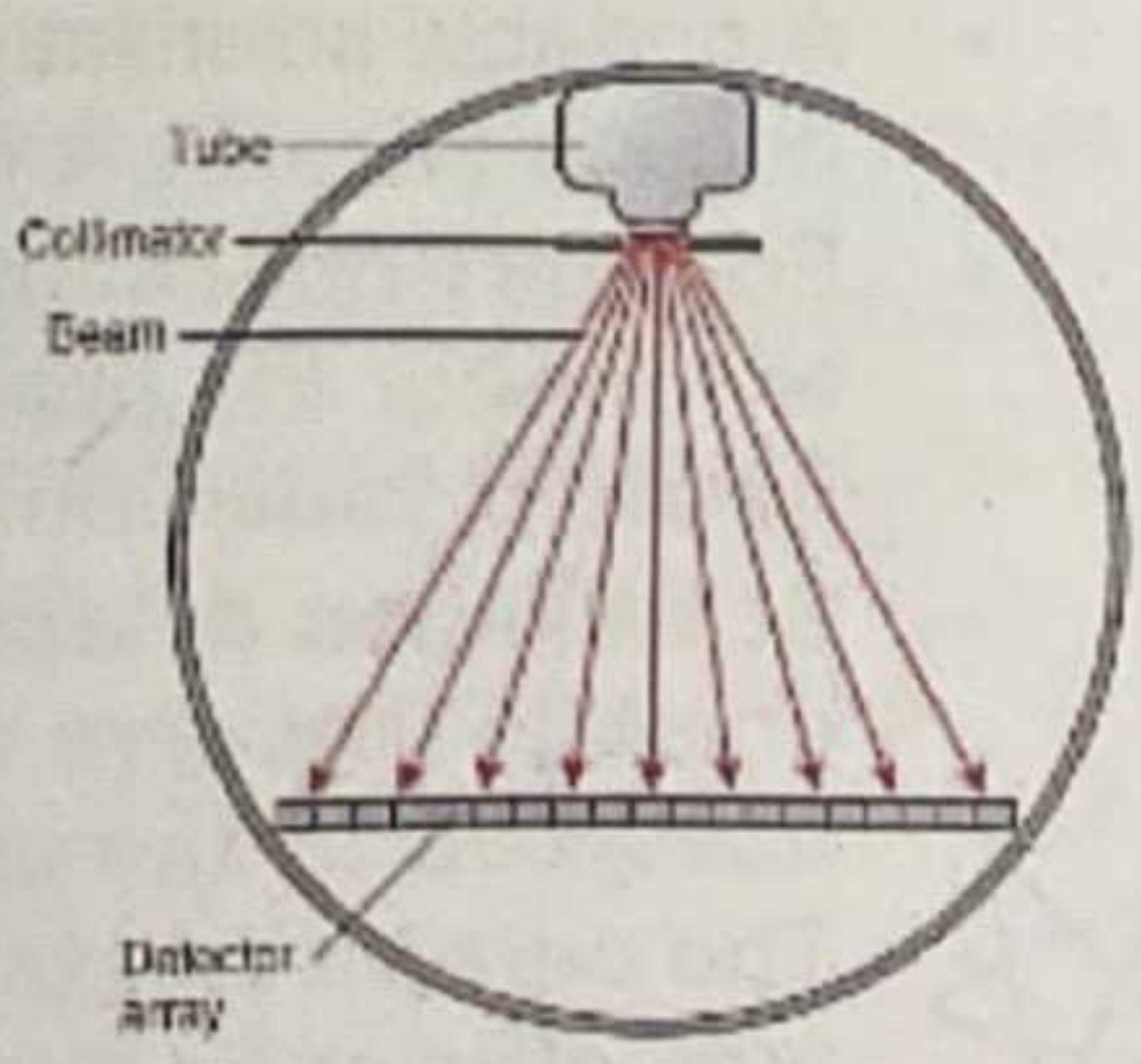
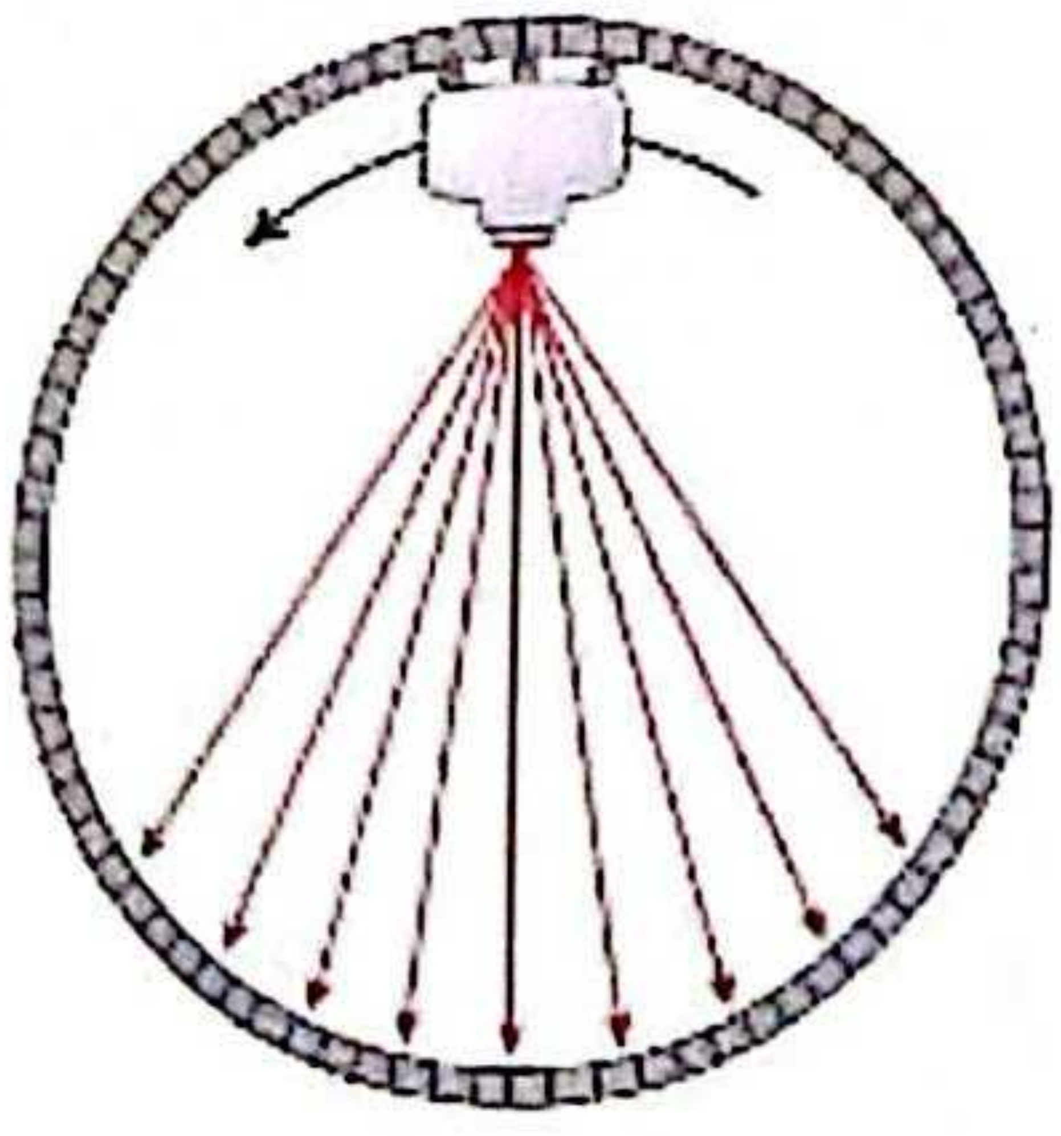

Scan 90
Scan 45
Scan 135
Narrow fan beam
Detector array
Scan 135
Scan 45
Scan 90

Figure 17.2. Shows a schematic view of a first-generation CT scanner.


Tube
Collimator
Beam
Detector array

re 17.3. Second-generation CT scanner.



ure 17.5. Fourth-generation CT scanner.

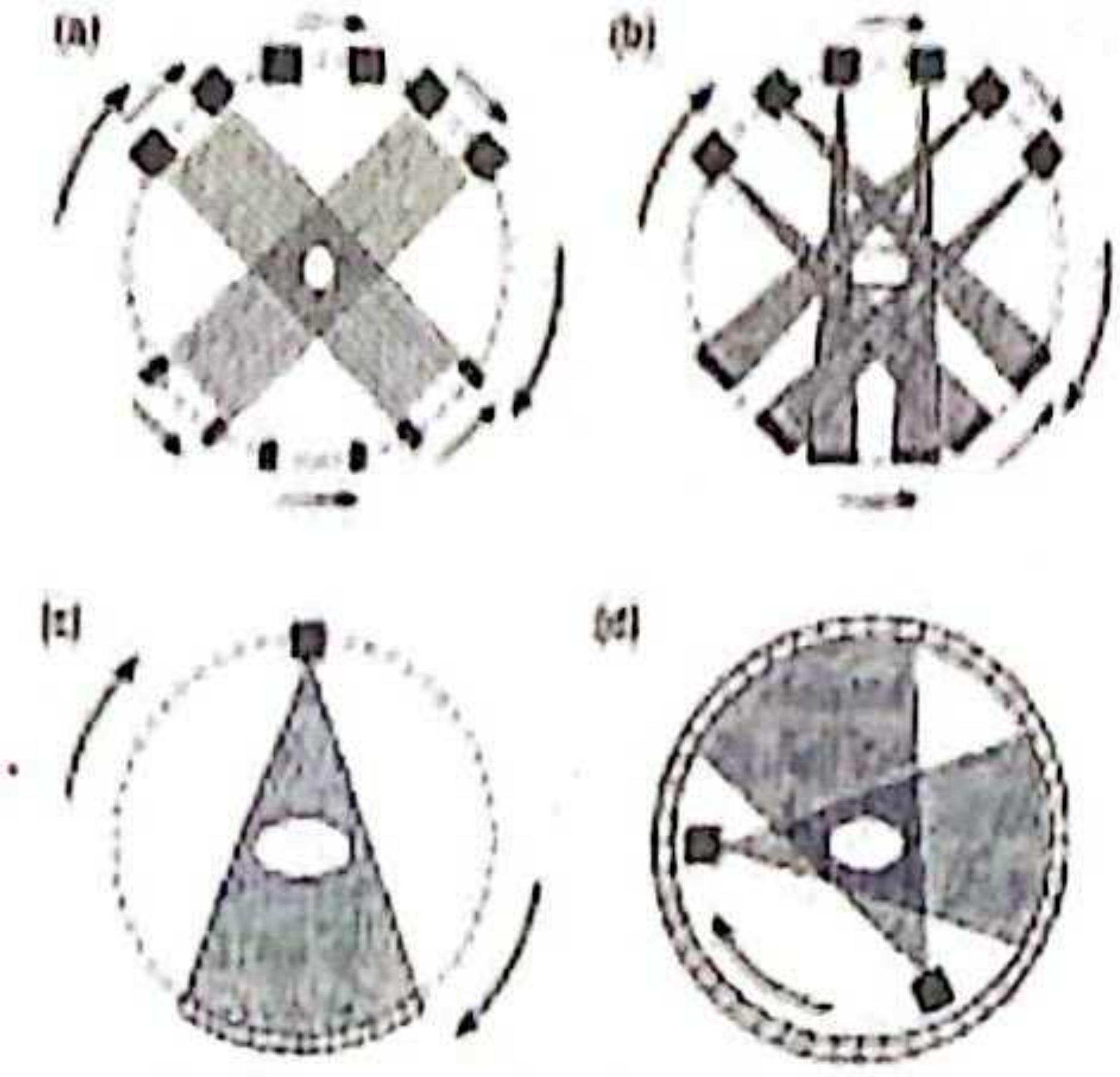
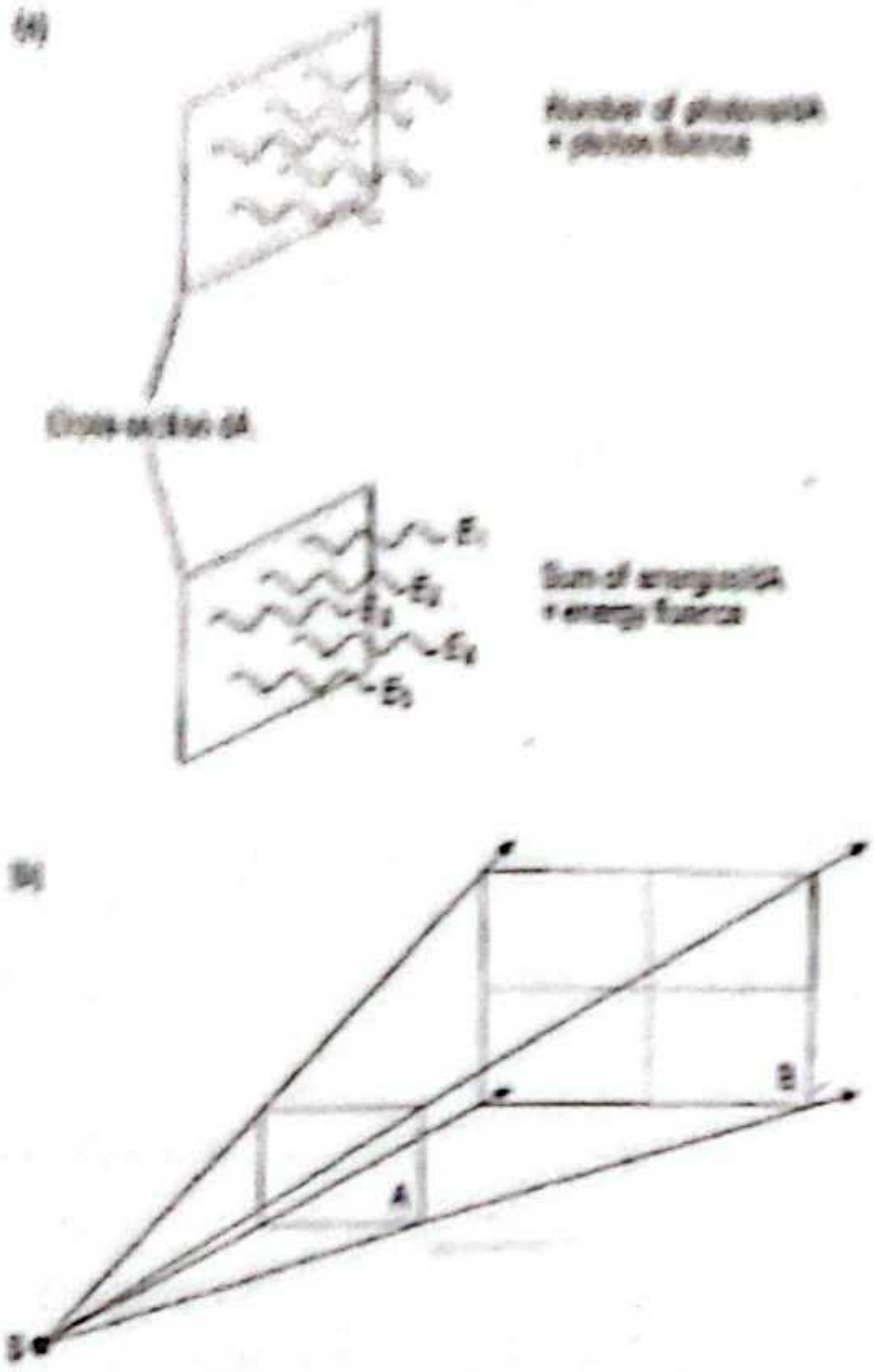


Figure 7.3 The development of the computed tomography scanner from (a) first to (d) fourth generation.

- The first-generation CT scanner was a single ray system designed to examine only the head. This scanner used two detectors and a single x-ray tube. The first-generation scanner used a translate-rotate system.
- The second-generation CT scanner used a single projection fan-shaped beam and a linear array with up to 30 detectors. The translate-rotate mechanism was used, and with the increased number of detectors, there were fewer linear movements.
- Fourth-generation scanners use a single projection fan shaped beam with 600 to 2,000 detectors mounted to an array which forms a 360 degrees ring on the inside of the gantry. The ring of detectors remains stationary, while the x-ray tube rotates within the gantry. **A principle disadvantage of fourth-generation scanners is the increased dose of radiation to the patient.** Fourth-generation imaging systems were developed because they are free of ring artifacts
- The fifth-generation scanner is a dedicated cardiac unit designed around a rotating electron beam. This type of scanner is also called the Electron Beam CT scanner (EBCT).
- The sixth-generation scanner was designed to use slip-ring technology to replace the cables. The slip-ring technology allows continuous rotation of the x-ray tube and detectors around the patient. The primary advantage of the helical scanning is a dramatically shorter scan time; spiral CT examinations can be completed in <1 minute.

Q.7) (2017)


(a)
Number of photons/dA = photon fluence
Cross-section dA
Sum of energies/dA = energy fluence
E_1
E_2
E_3
E_4
E_5
(b)
A
B
S

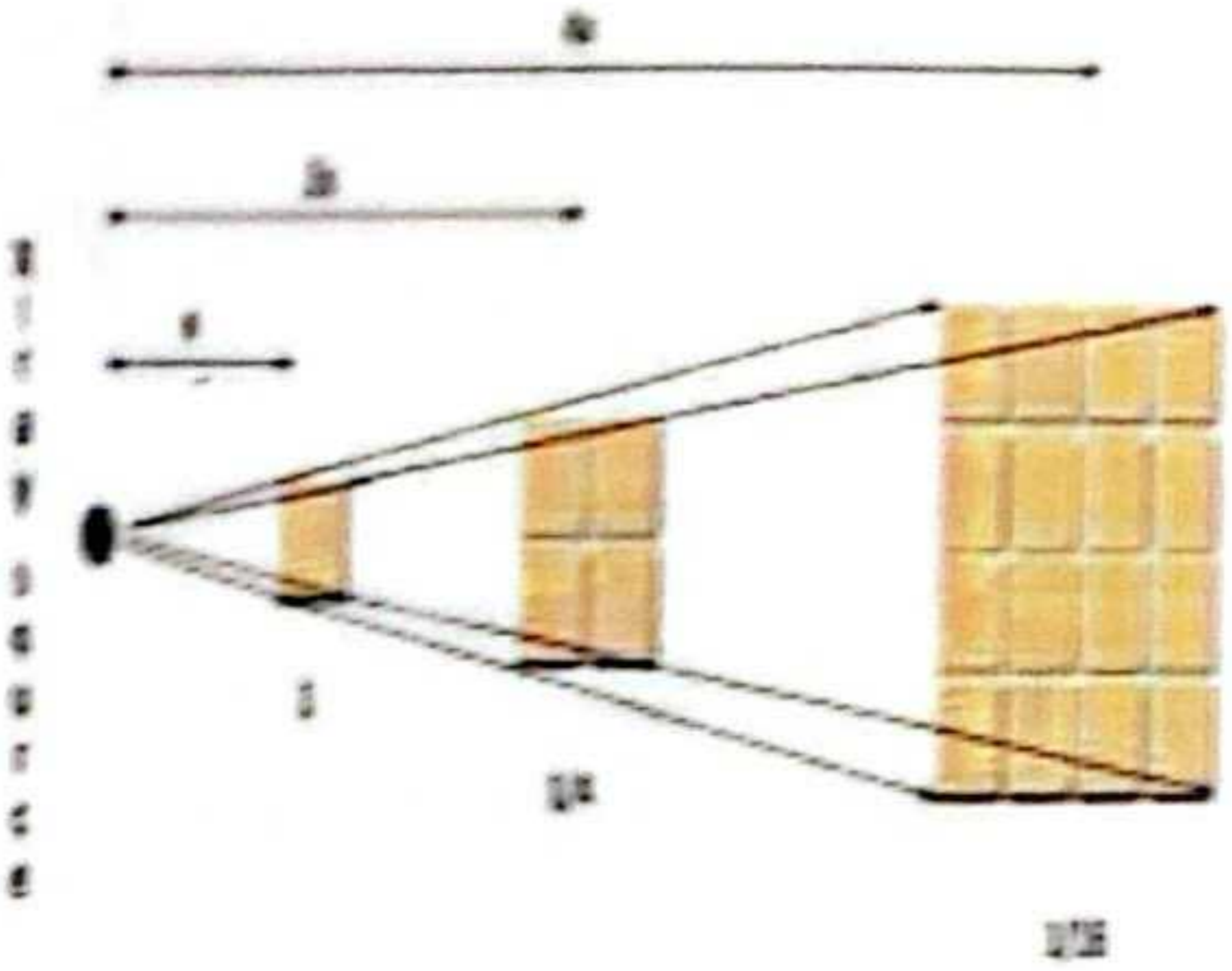


Figure 1.3 (a) Photon fluence and energy fluence. (b) The inverse square law applying to a point source S.

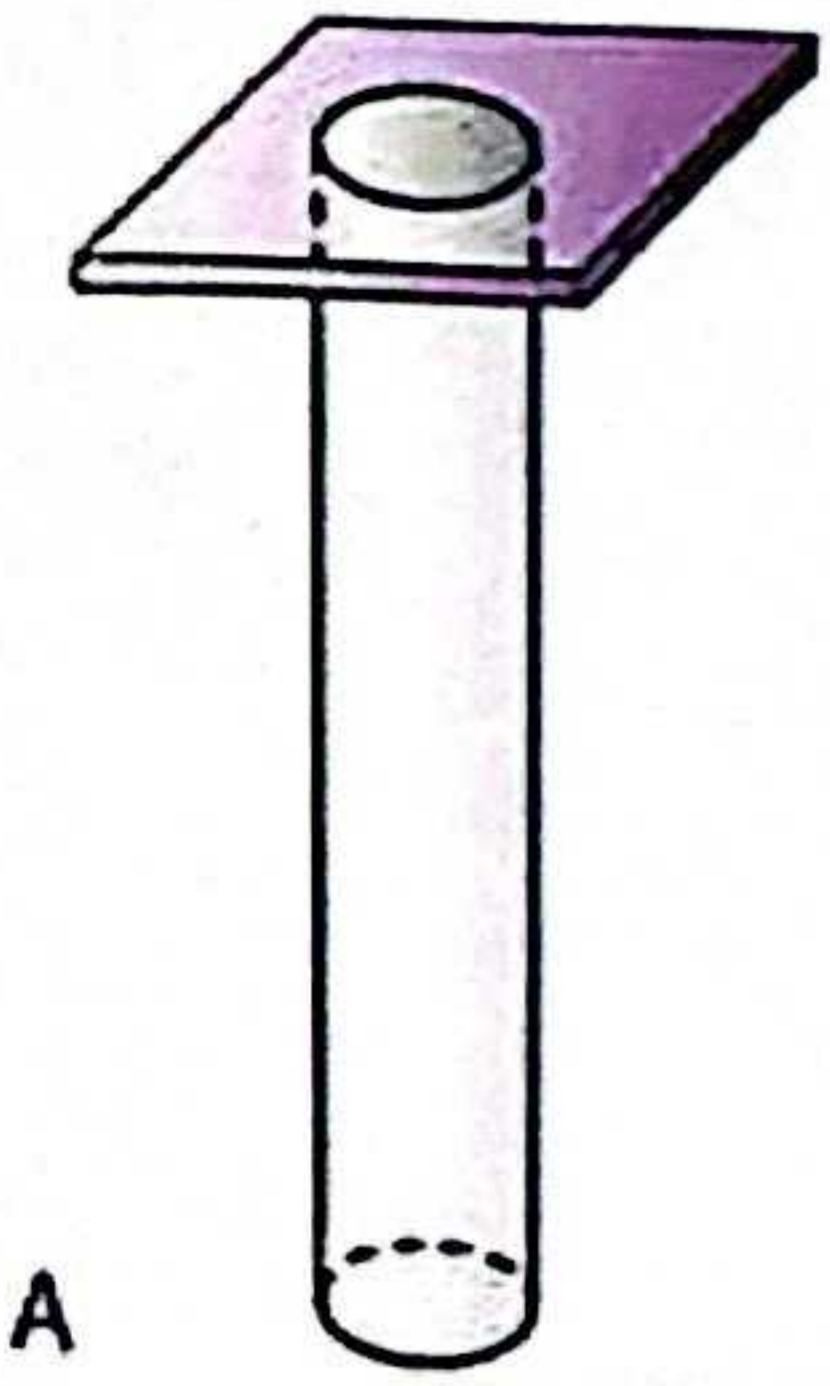
The inverse square law describes the principle of dose reduction as distance from the source increases.

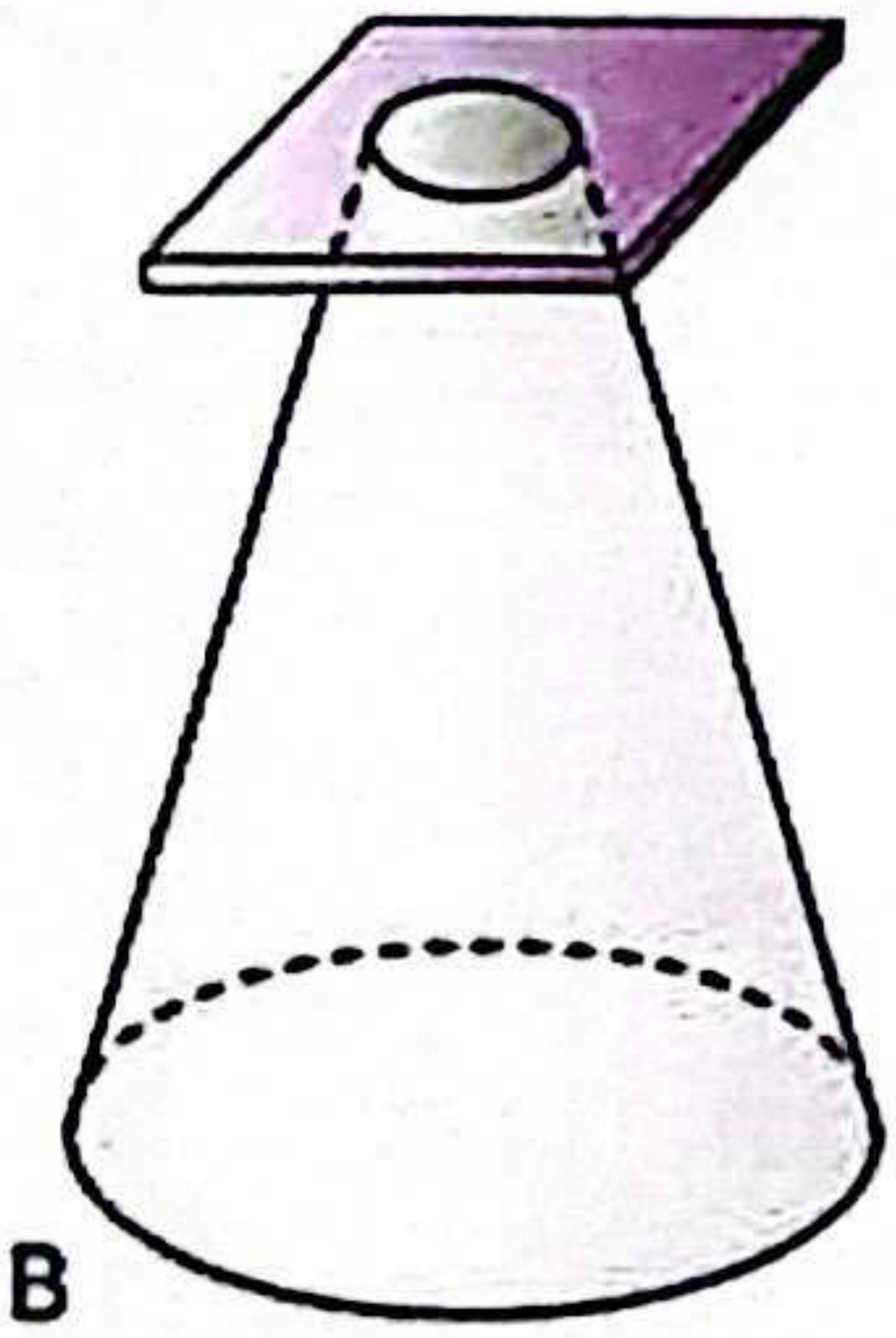
The area of the beam is proportional to the square of the distance from a point source. Therefore the air kerma is inversely proportional to the square of the distance from the source. P — PBa

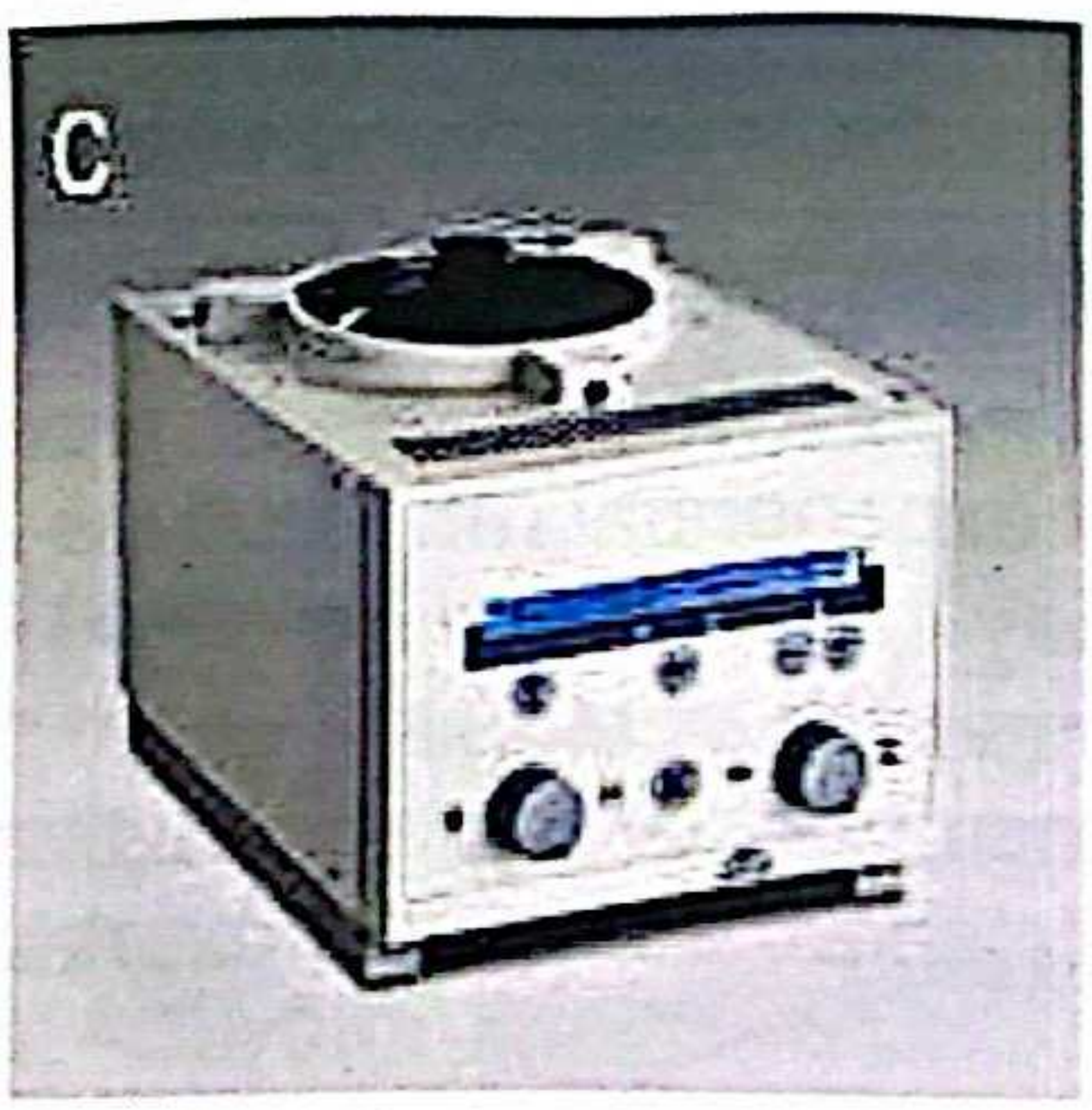
Beam Intensity/Energy fluence rate:
is energy flow per second and is measured in watts/cm^2. The intensity of the radiation decreases with an increase in the distance from the source

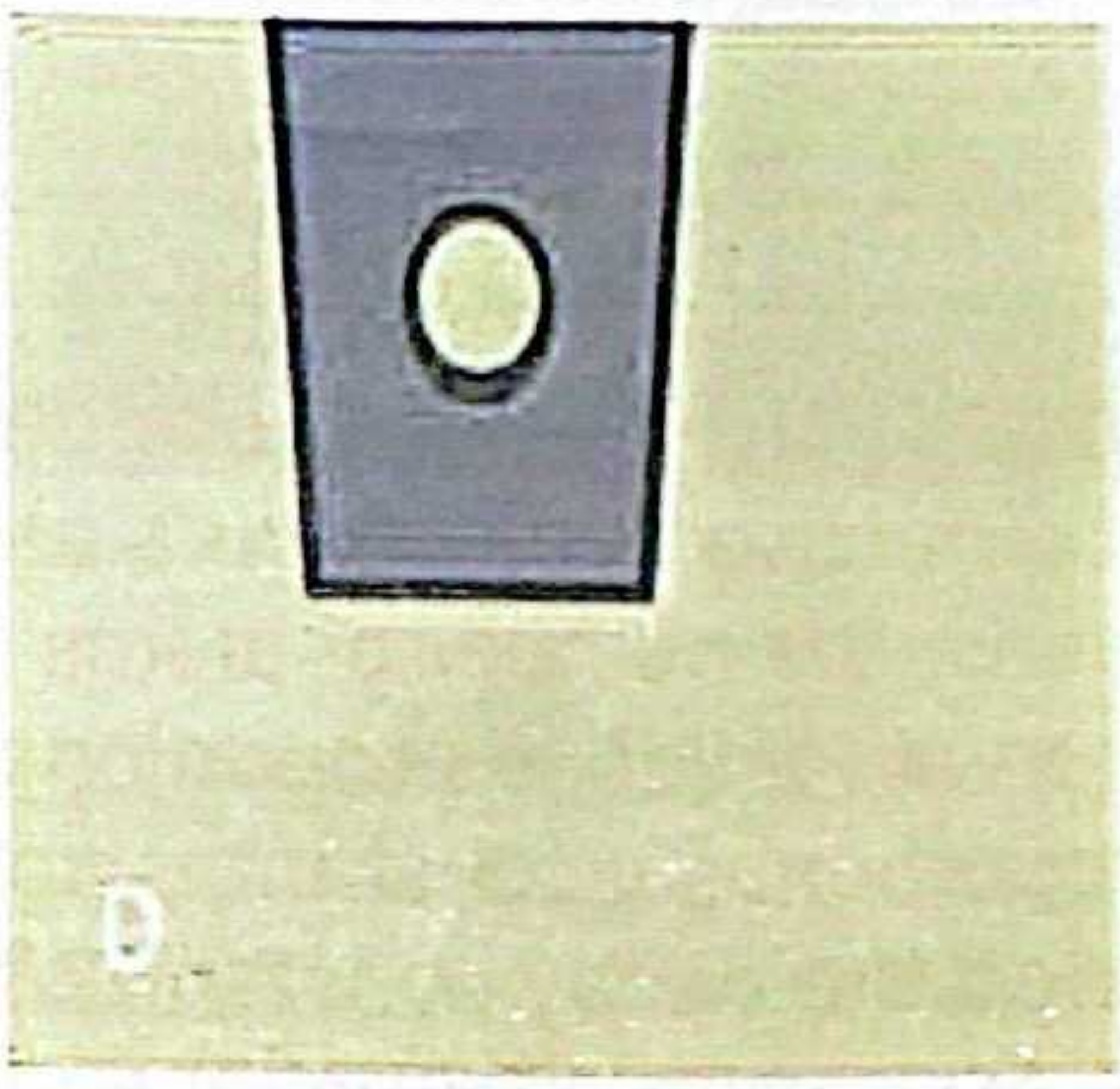
A collimated set of rays is called a beam.

Q.8) (2016)





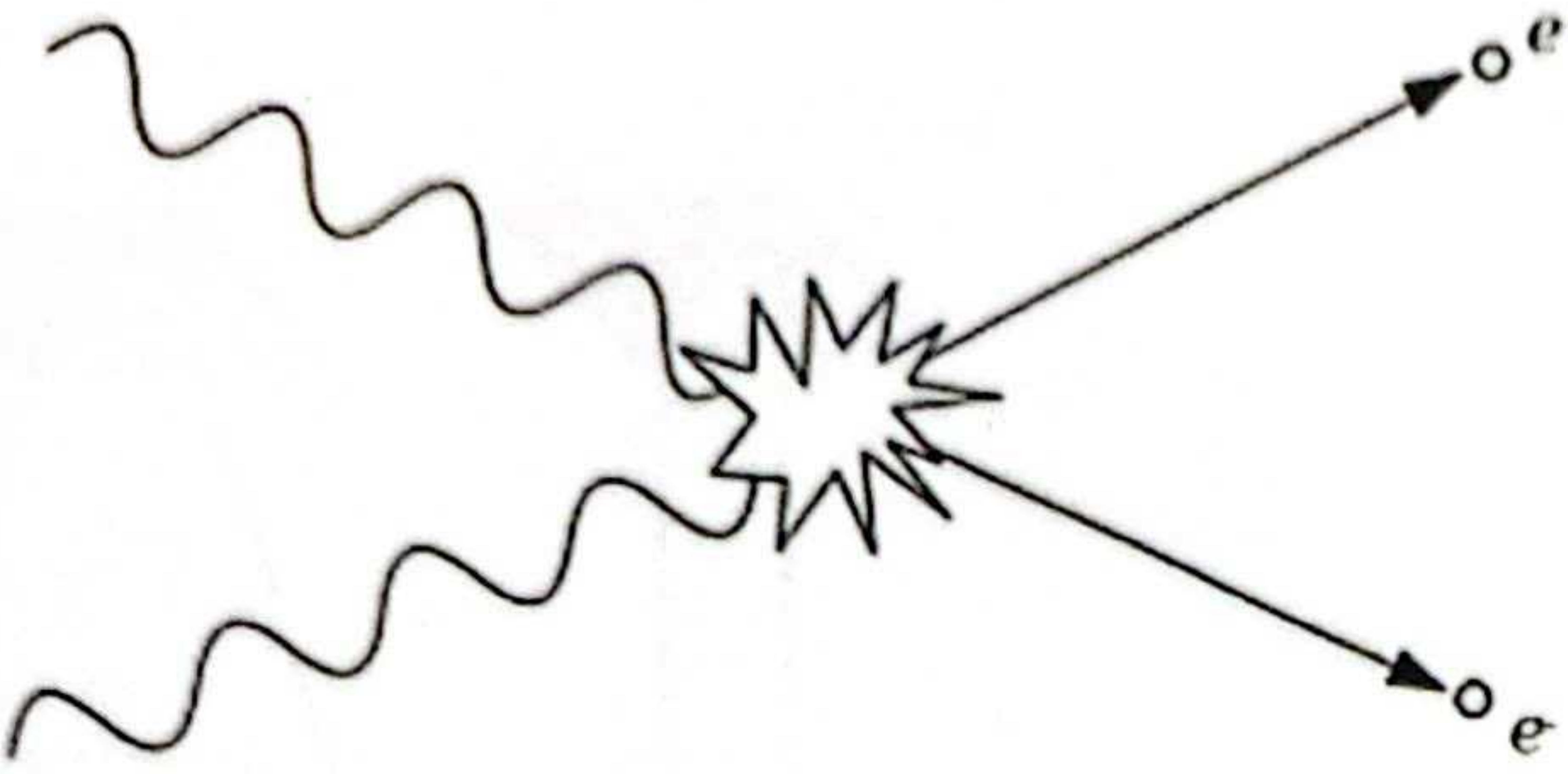




Beam restricting devices

A. Cylinder
B. Cone
C. Variable aperture automatic collimator
D. Diaphragm

Q.9) **(2016)**



Name the process in diagram:
Pair Production

Definition:
Pair production an interaction between x-ray photons and the force field of the nucleus of an atom resulting in the x-ray photon energy being completely converted into a positive and negative electron

What is the law of exponential decay of radioactivity?
Radioactive decay occurs as a statistical exponential rate process. That is to say, the number of atoms likely to decay in a given infinitesimal time interval (dN/dt) is proportional to the number (N) of atoms present. The proportionality constant, symbolized by the Greek letter lambda, λ, is called the decay constant. Mathematically, this statement is expressed by the first-order differential equation,

$Dn/Dt= \lambda N$

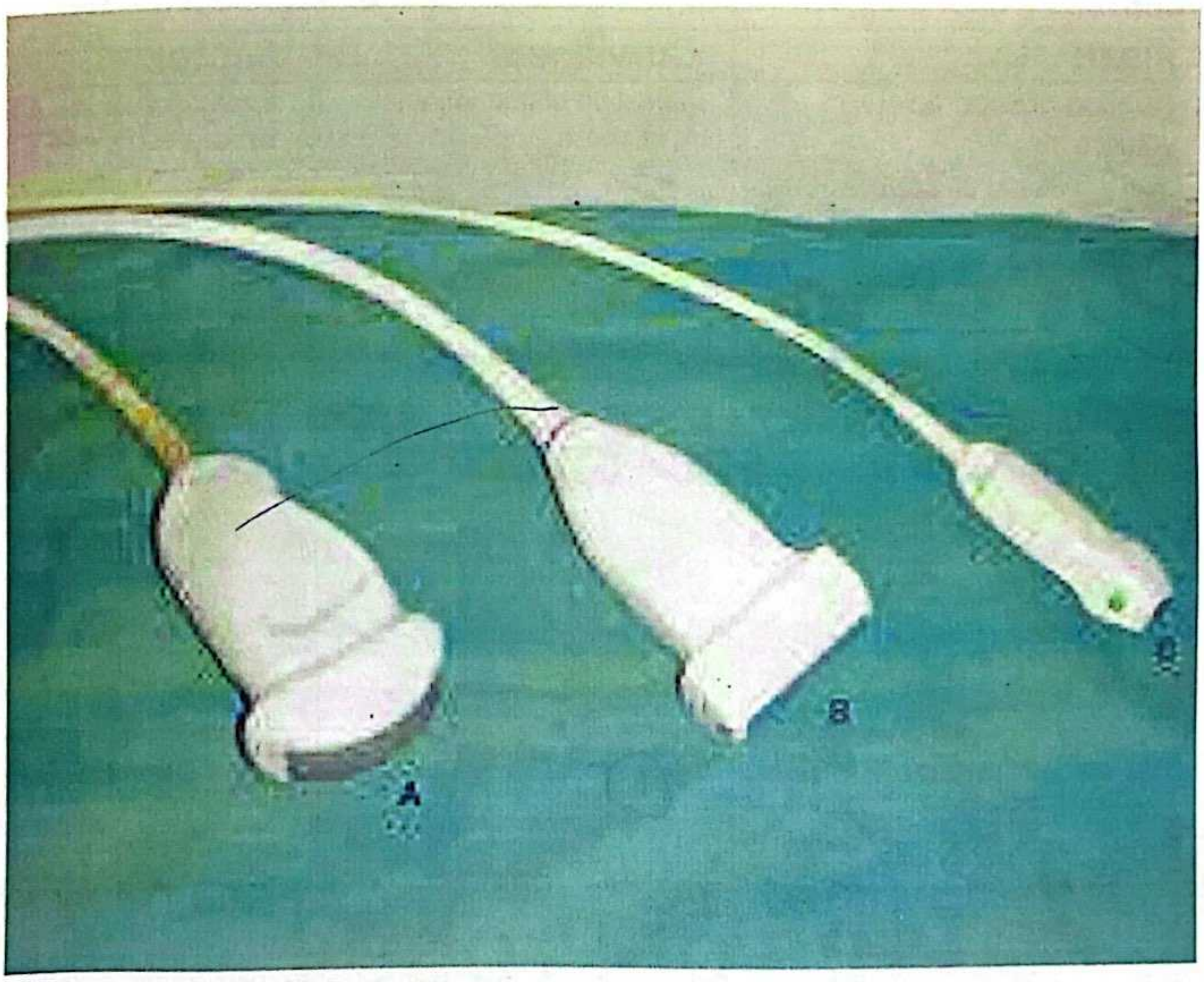
What is the SI unit of Radioactivity?
Becquerel

Radioactive decay:
The transformation of radioactive nuclei into a different element followed by the emission
of particulate or electromagnetic radiation.

Isotopes:
Atoms of the same element whose nuclei contain the same number of protons but a different number of neutrons are called isotopes

Q.10) **(2015)**

Idenify U/S probes?



Which one has highest resolution?
Which has highest depth range?
Which one is used for neonatal brain imaging?

- **A. Curvilinear** ✓
- **B. Linear.** ✓ R↑
- **C. Sector** D↑

- Linear has highest resolution.
- Sector has highest depth.
- Sector is used for neonatal brain.

Sector scan versus linear scan

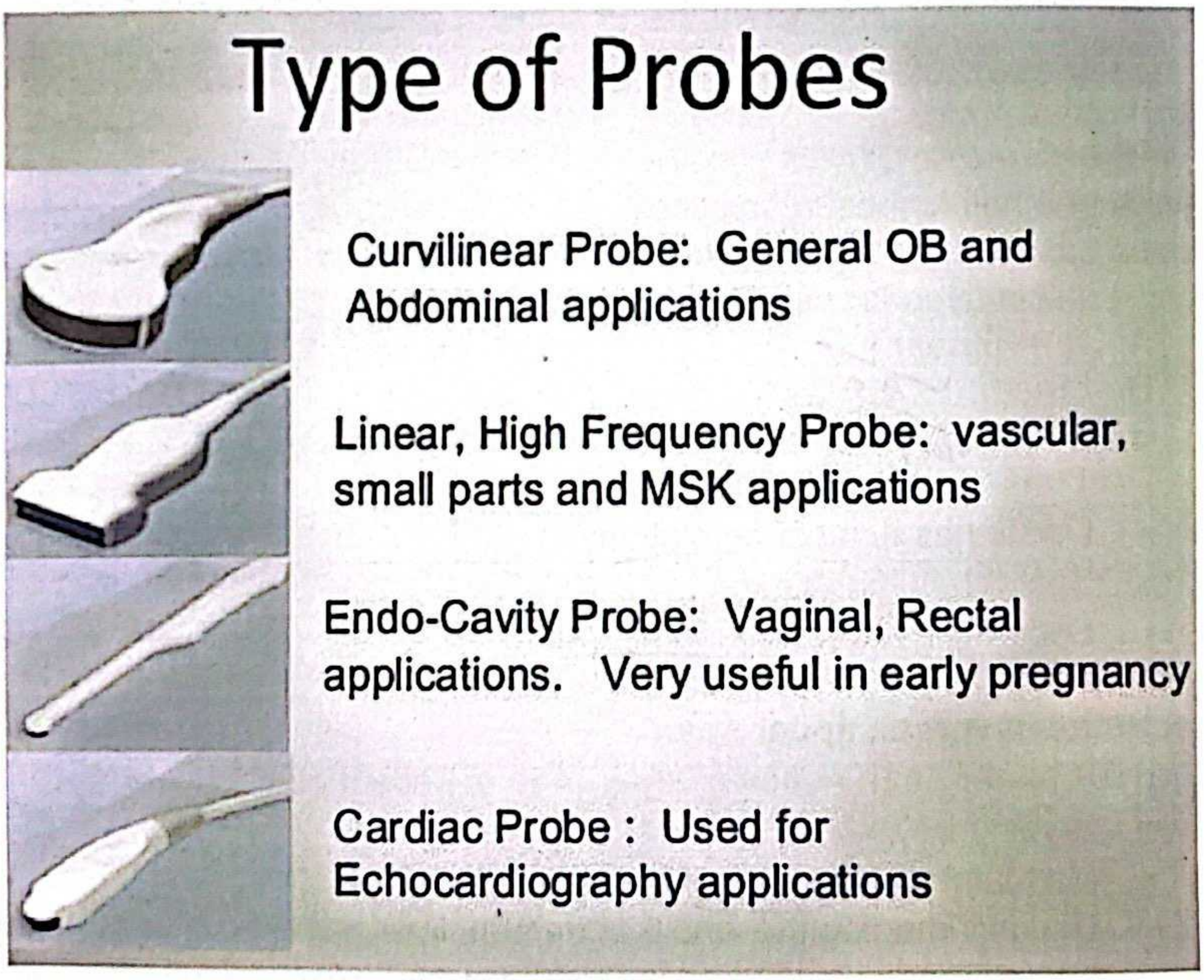
- A **linear scan** needs a larger area of patient contact
- Gives a better-quality image
- Maintains a wide field of view near the skin
- Used in imaging the whole abdomen, liver, superficial vessels and thyroid, and is also used in obstetrics and gynaecology.
- A **sector scan** is easier to manipulate
- Requires a smaller acoustic window
- Has a narrower field near the skin but a wider field at depth

- Used to image the heart through intercostal spaces or subcostally and the **infant brain** through the fontanel.
- It is also used in intracavitary probes.

Uses:

10-14 mHz

Linear:	**Curvilinear**	**Sector**
Evaluation of superficial structures: 1. Vascular applications 2. Thyroid/breast 3. Joints/tendons 4. Ophthalmologic 5. Lung 6. Procedural guidance: 7. Abscess/foreign body 8. Peripheral/central venous access 9. Nerve blocks	Evaluation of abdominal structures: 1. Hepatobiliary 2. Renal 3. Appendix (pediatric) 4. Aorta 5. Focused assessment with sonography for trauma 6. Fetal heart tones and obstetric complications 7. Bedside lung ultrasound in emergency 8. Procedural guidance: 9. Paracentesis and thoracentesis	Evaluation of thoracic structures: 1. Echocardiography 2. Lung ultrasound 3. Evaluation of abdominal structures as an 4. alternative to curvilinear probe 5. Procedural guidance: 6. Thoracentesis 7. Pericardiocentesis



Type of Probes

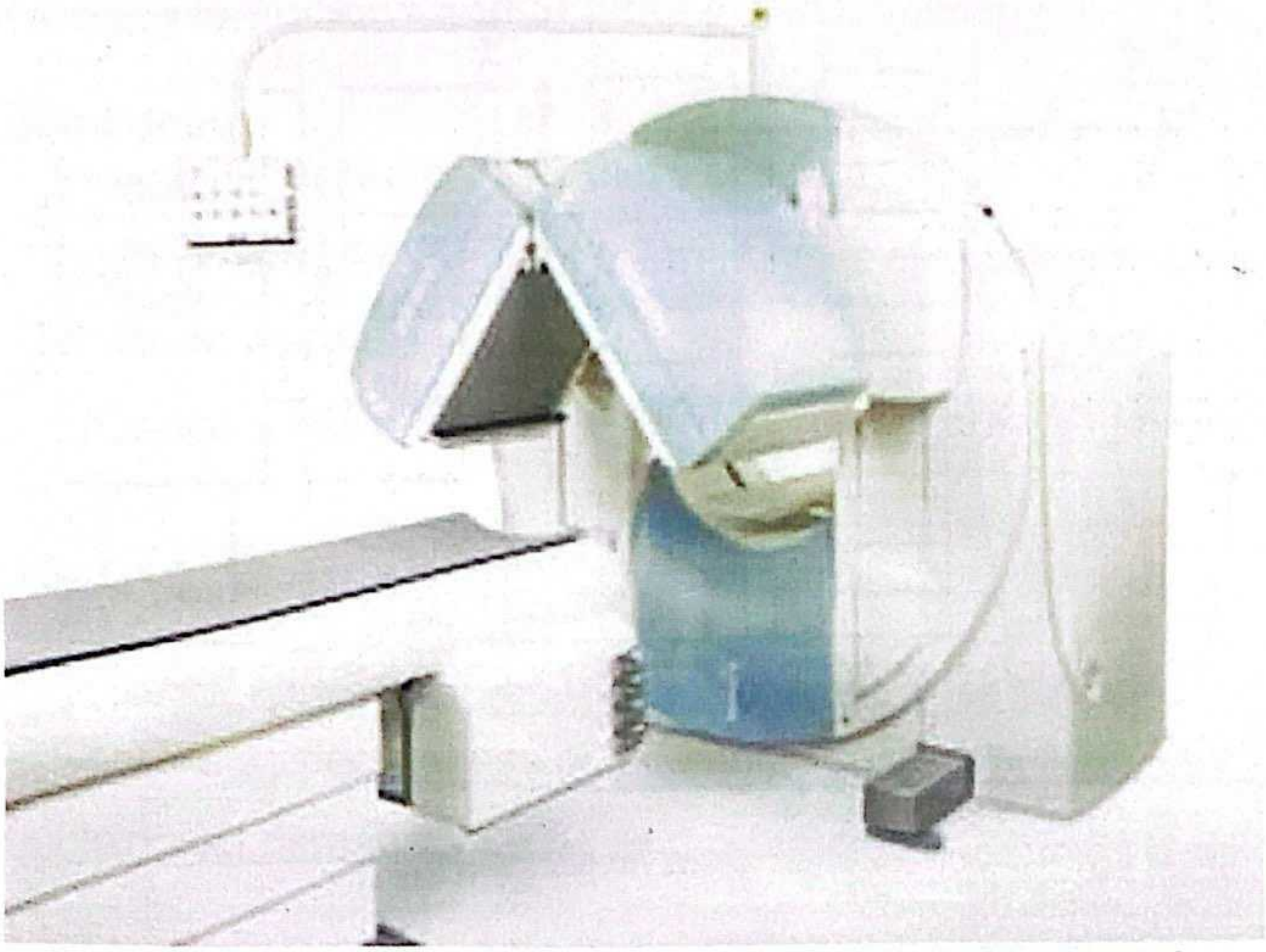
Curvilinear Probe: General OB and Abdominal applications

Linear, High Frequency Probe: vascular, small parts and MSK applications

Endo-Cavity Probe: Vaginal, Rectal applications. Very useful in early pregnancy

Cardiac Probe : Used for Echocardiography applications

Q.11) **(2015)**



Single photon emission computed tomography-Spect CT- Dual Gamma Camera

Technetium Half Life: 6 hours

A positron or PET camera comprises a ring, hexagon or other polygon surrounding the patient and Composed of a very large number of solid scintillation detectors (10000-20000), often of **bismuth germanate (BGO).**

Other efficient scintillators, such as lutetium oxyorthosilicate (LSO) or gadolinium oxyorthosilicate (GSO), are also in use.

1. Readily available
2. Cheap to produce
3. Easy to manufacture into crystal blocks
4. High detection efficiency - to absorb and convert 511 kev photons into light
5. Very short scintillation decay time
6. Good energy resolution

To reduce the random and scatter events from adjacent rings, narrow lead or tungsten septa (about 1 mm thick by up to 10 mm deep, can be used between each ring of detectors to act like a **parallel anti scatter grid** in radiography.

OLO

Uses:

1. Surgical evaluation of uncontrolled sizures
2. Stress fractures in spine
3. Blood deprived areas of brain after stroke
4. Tumors

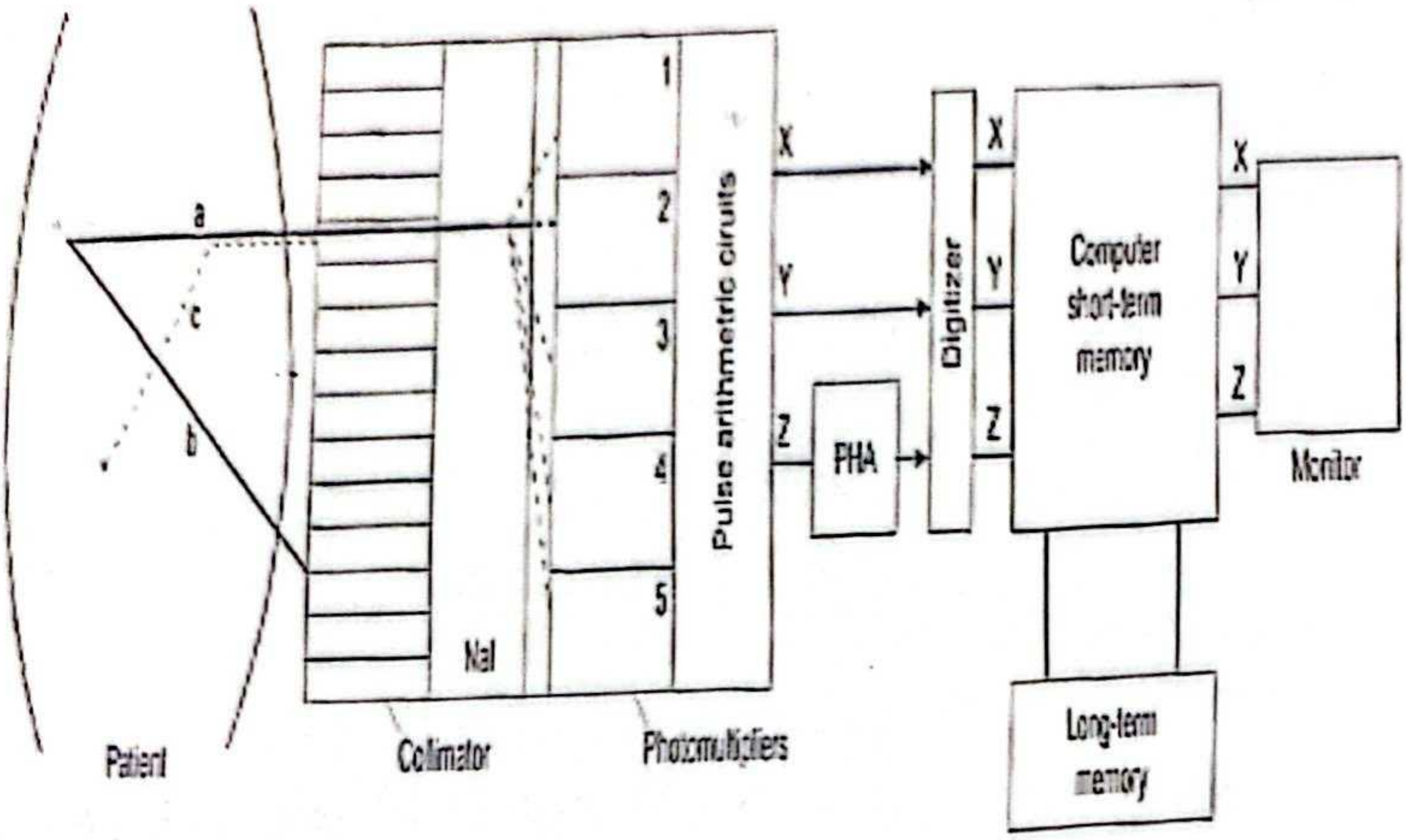

a
c
b
1
2
3
4
5
Pulse arithmetic circuits
X
Y
Z
PHA
Digitizer
X
Y
Z
Computer short-term memory
X
Y
Z
Monitor
Long-term memory
NaI
Patient
Collimator
Photomultipliers

Figure 8.6 A gamma camera with a parallel hole collimator. PHA, pulse height analyser.

Table 8.1 Half-lives of some radionuclides used in imaging

Half-life	Radionuclide
13 s	Krypton-81m
1 min	Rubidium-82
10 min	Nitrogen-13
20 min	Carbon-11
68 min	Gallium-68
110 min	Fluorine-18
6 h	Technetium-99m
13 h	Iodine-123
67 h	Molybdenum-99
67 h	Indium-111
73 h	Thallium-201
78 h	Gallium-67
5 days	Xenon-133
8 days	Iodine-131
200000 years	Technetium-99

Q.12) **(2014)**

What are the definitions and SI units of the following? E/T

Absorbed dose:

- Energy deposited per unit mass of tissue
- Doesn't consider effect for different types of radiation or sensitivity of different organs irradiated
- Entrance surface dose (ESD) = gray (Gy) (1 gray = 1 joule/kg)

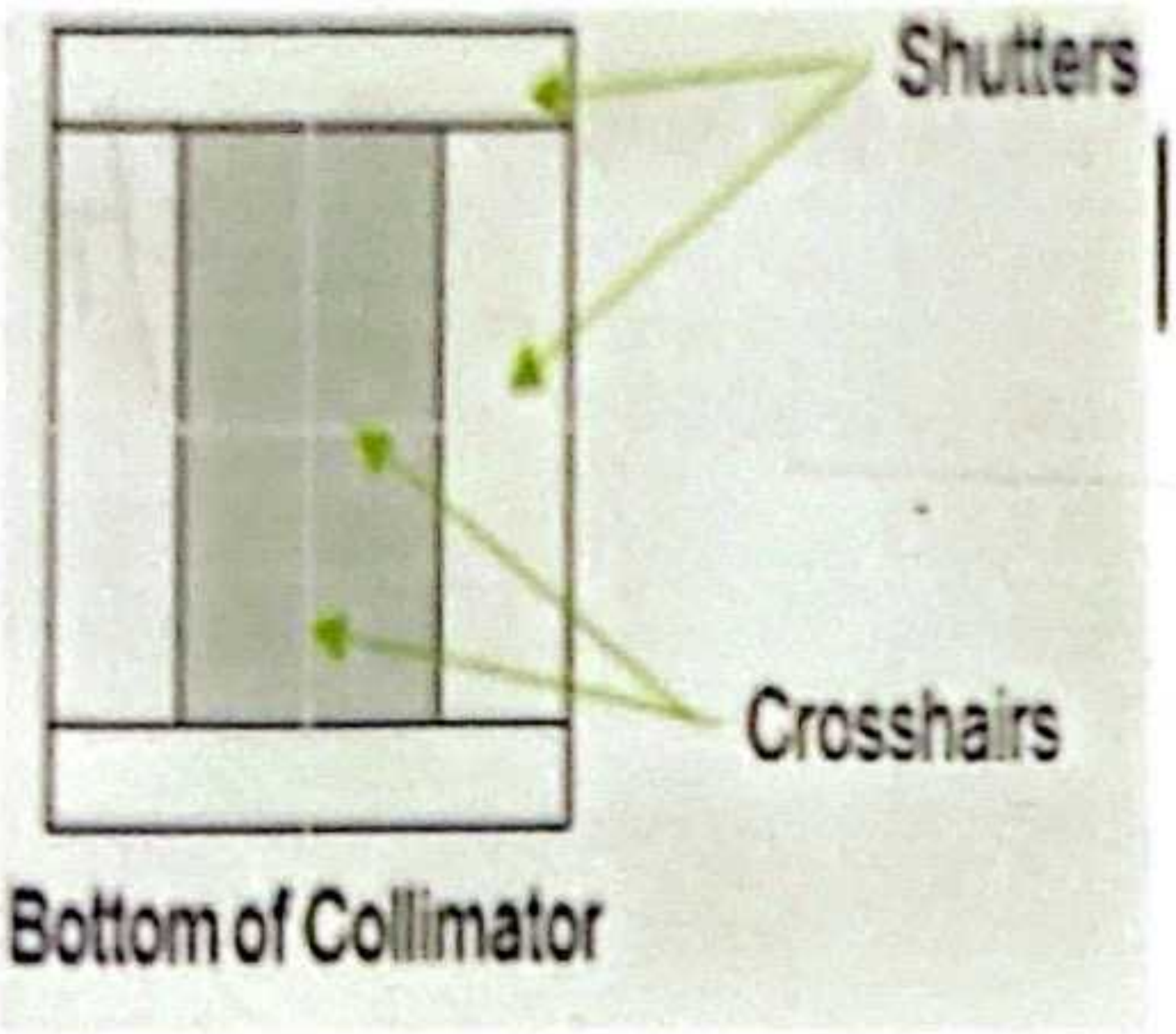
Equivalent dose: ESDα

- Entrance surface dose x radiation weighting factor
- Considers effectiveness of different radiation types in producing biological damage
- Sievert

Effective dose:

- Sum of (equivalent dose x tissue weighting factor)
- Sensitivity of different tissues to radiation taken into account
- Sievert

Q.13)


Shutters
Crosshairs
Bottom of Collimator

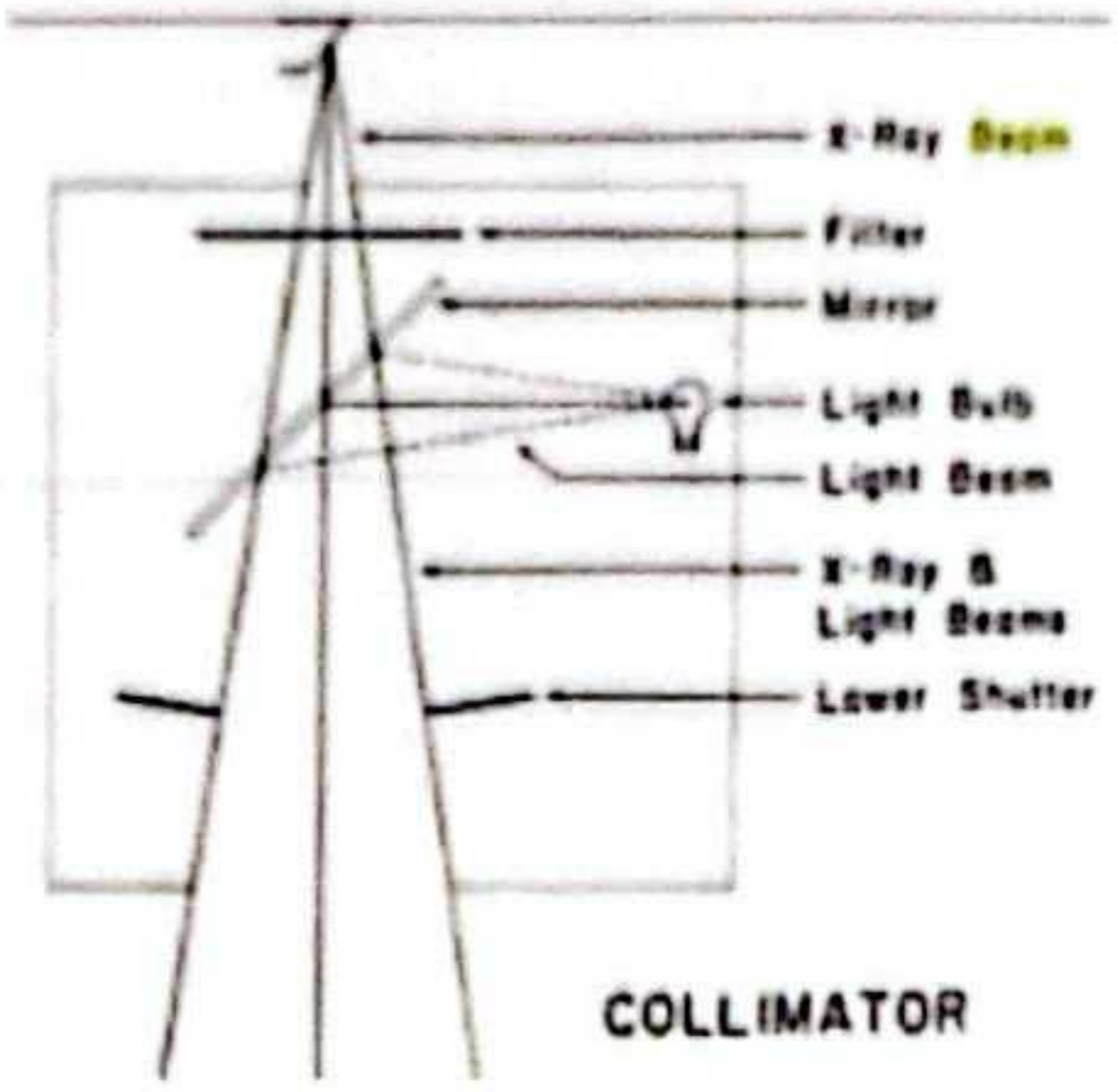
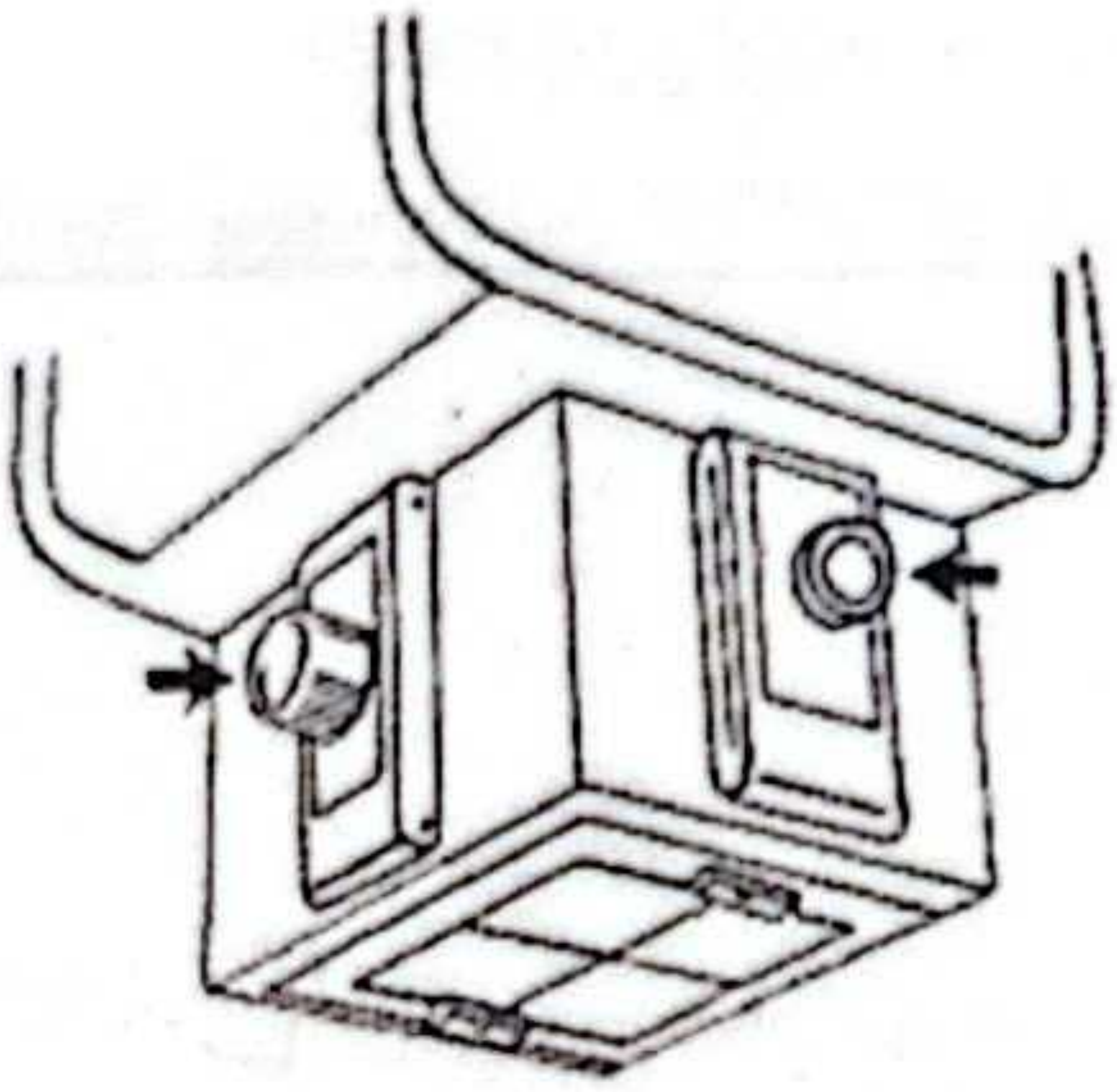
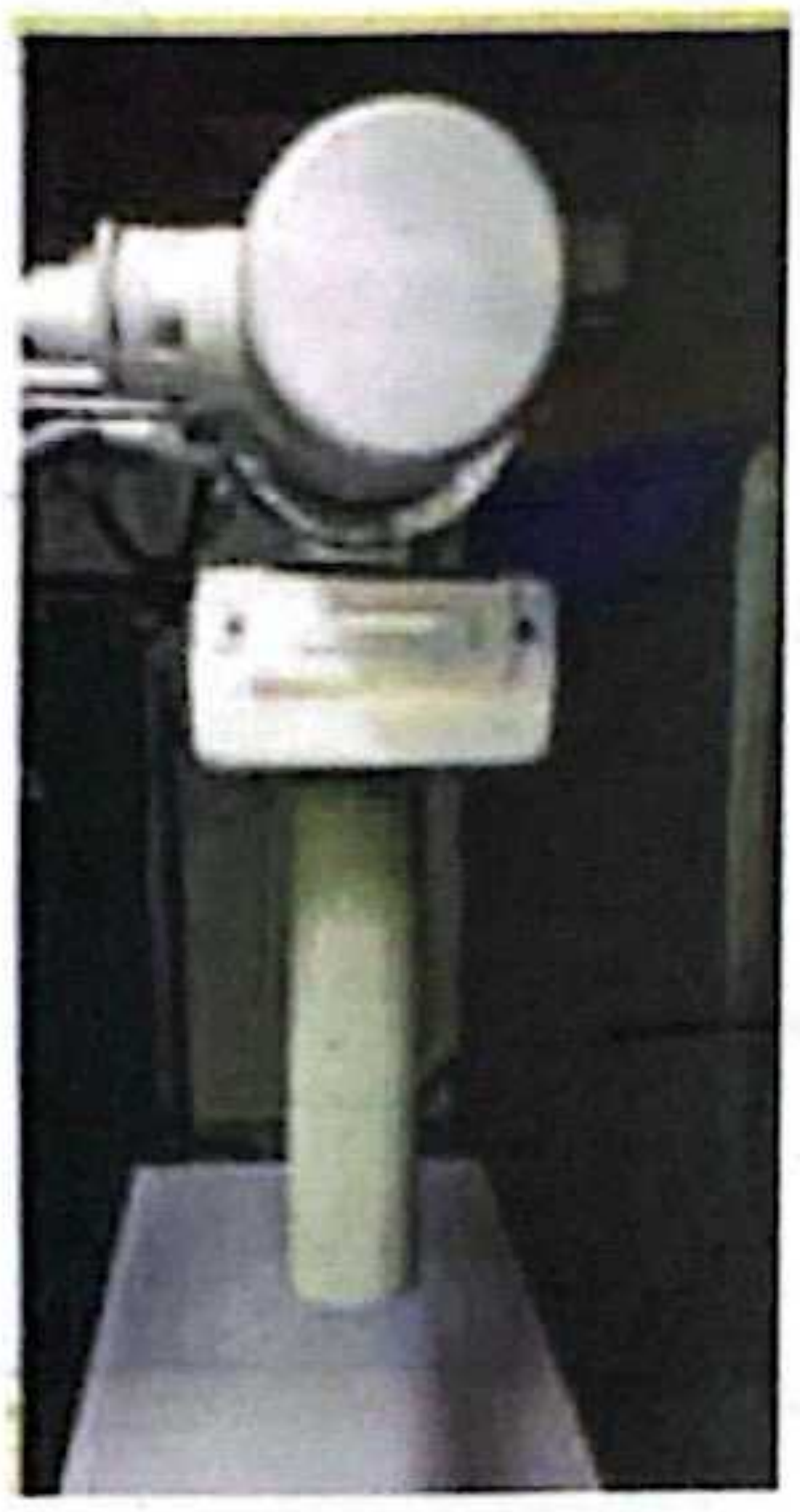
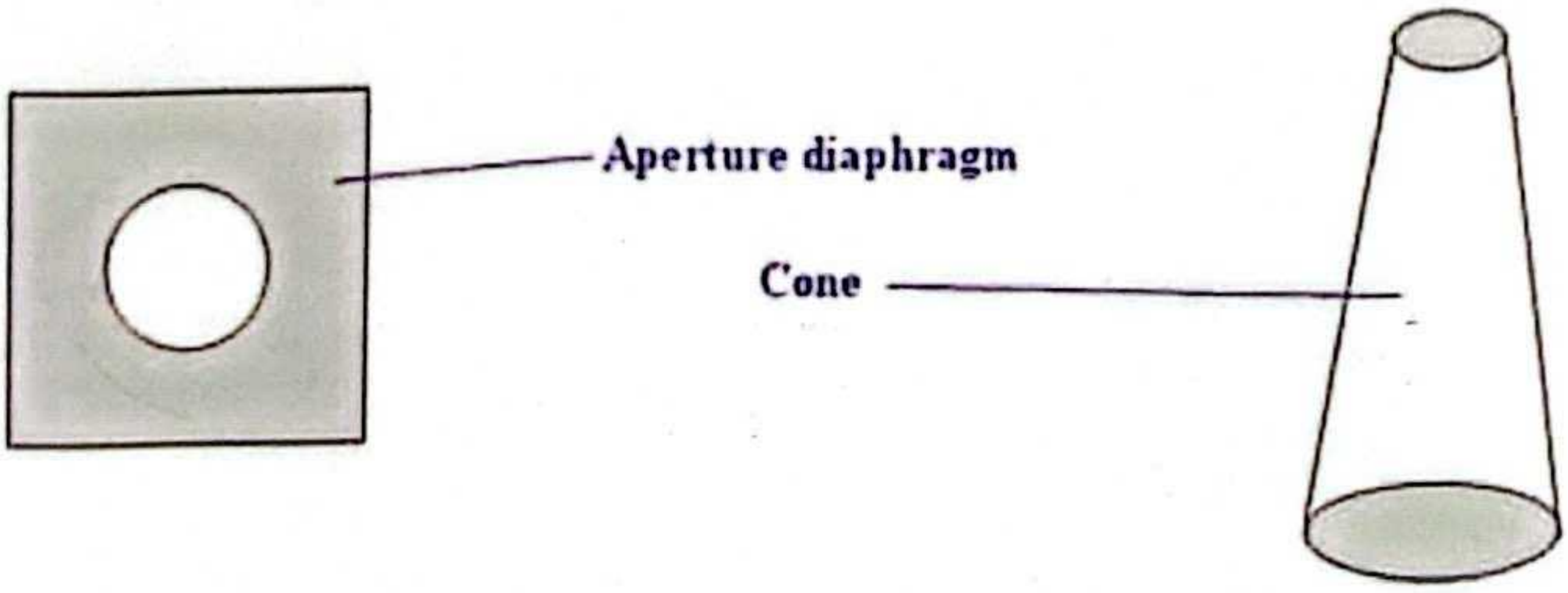

X-Ray Beam
Filter
Mirror
Light Bulb
Light Beam
X-Ray & Light Beams
Lower Shutter
COLLIMATOR

Figure 5-3



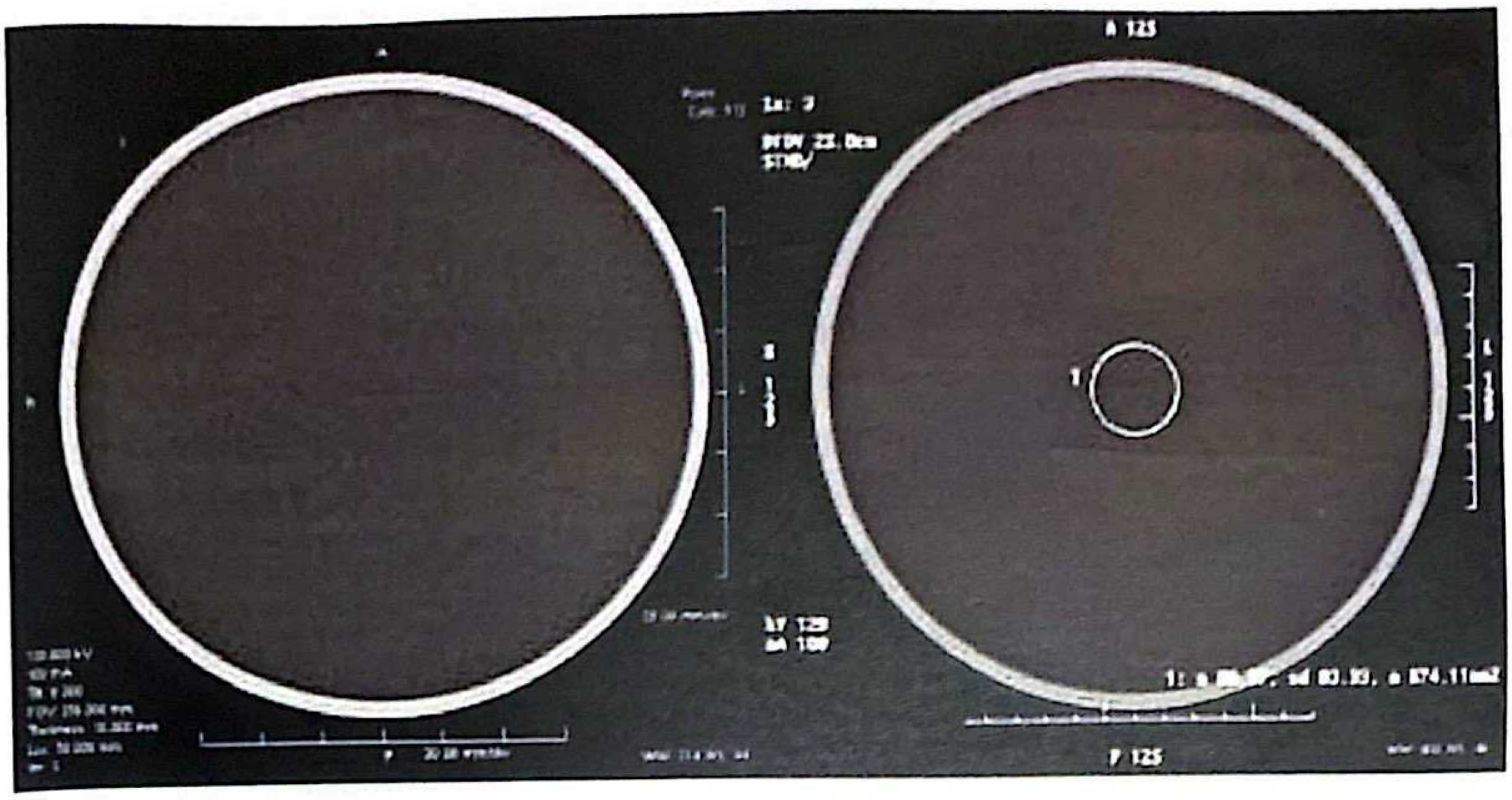



Aperture diaphragm
Cone

Beam restricting devices

- X ray collimator
- Conical and cylindrical
- Circular diaphragm

Q.14) **(2014)**



CT image of Water bath phantom

#P 17

What is noise:

There is random variation in the number of photons forming each part of the image, called noise, that can obscure the signal received from the subject. The amount of noise is proportional to the square root of the total number of photons.

$N \propto \#^2$

↑#

How can noise be reduced?

Reducing the proportion of noise in an image will improve the quality. The main way to achieve this is the increase the number of photons detected and used to form each image pixel / element. This can be done in several ways.

1. Increasing the dose (mA): higher number of photons and smaller proportion of noise
2. Using an image receptor with a greater attenuation coefficient: more photons are absorbed and converted into a signal
3. Make the image receptor thicker: again, more photons will be absorbed and converted into a signal
4. Using larger detector elements: more area to absorb photons per pixel. However, the spatial resolution will decrease

Dose

[illegible]

Unsharpness

There are four causes of unsharpness:

a. Geometric unsharpness

b. Image receptor unsharpness

c. Movement unsharpness

d. Edge unsharpness

Define Pitch:

For single slice:

- Table top mounted per rotation/collimation width

For multi slice:

- Table top mounted per rotation/collimation length

Beam pitch:

- Table top mounted per rotation/slice thickness

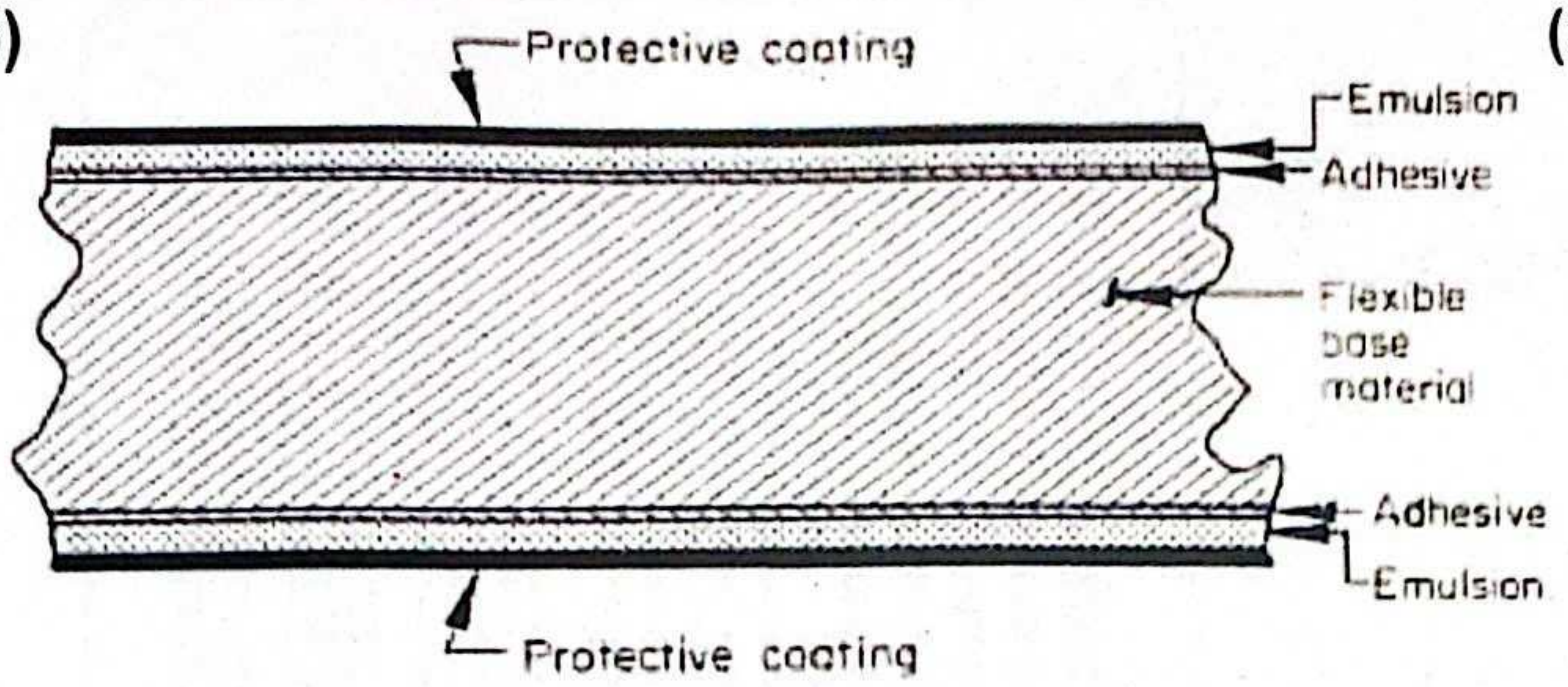
Pixel size inversely proportional to spatial resolution

- Small pixel size>increase spatial resolution

O SPT

TT/RSL

Q.15) **(2014)**



Name:
- Conventional radiographic film

Protective layer
- Emulsion

Adhesive layer
- Polyester base

Steps of film processing:

Wat De Run Fun We Do

Watering>Developing>Rinsing>Fixing>Washing>Drying

- **Calcium tungstate in intensifying screen**

Film

Types of screens
1. Double-sided radiographic film: emulsion layer of light-sensitive crystals coated onto both sides of a transparent base material. Used most in plain film imaging
2. Single-sided camera film: one emulsion layer only. Used in mammography
3. Non-screen film: x-ray photons used directly to expose film. Used in dental x-rays

Base:
- Clear polyester material about 150 μm thick
- Provides physical support of the other film components
- Does not participate in the image-forming process

Emulsion
- Active component in which image is formed
- Typically, 5 - 10 μm thick
- Consists of many small, irregularly-shaped silver halide crystals suspended in gelatine
- The silver halide used is typically silver iodobromide (90-99% bromide, 1-10% silver iodide)
- Each grain has a structural "defect" built in called the "sensitive spot". Each crystal is 1 μm large
- Most sensitive to light energy, not x-ray photons, so intensifying screens used

Q.16)

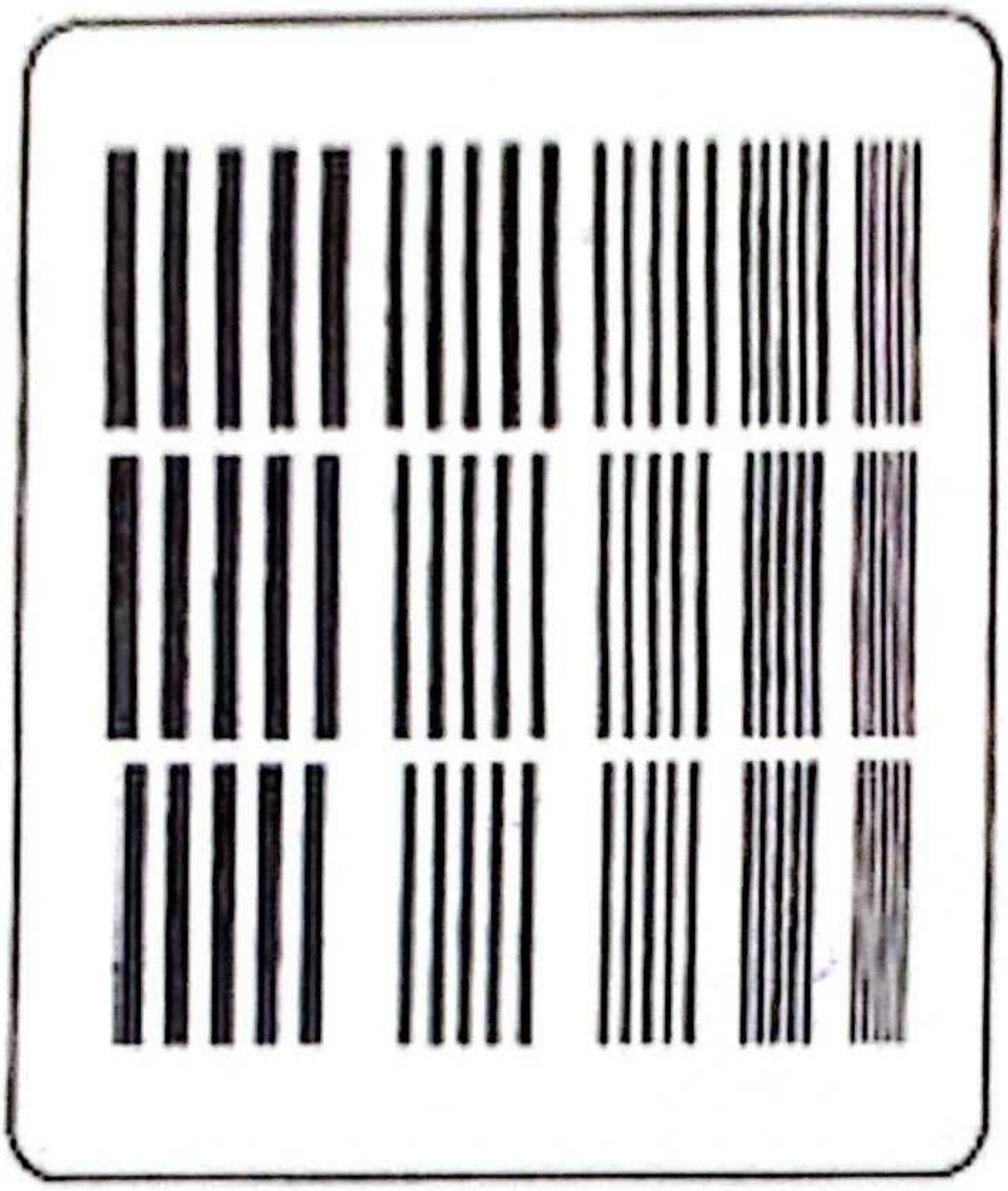


Figure 3.2 A grid test device for assessing limiting spatial resolution.

Name:

- Grid Test Device
- Lines Pair Test Pattern

Function:

- Assessing Limiting spatial resolution

Unit of spatial resolution:

- Lines pair/mm (In Radiography)
- Lines pair/cm (In CT, MRI, Gamma Camera)

11 = 12
13 15

It is more common to quantify spatial resolution as the highest occurring frequency of lines that can be resolved in a high-contrast bar pattern. **A test object used to determine spatial resolution** (fig. 3.2) consists of a number of equally spaced bars, the space between the bars being the same as the width of a bar. For X-ray imaging, the bars are strips of lead or tungsten fixed to a perspex plate. A bar and a space together make up a line pair, and the **spatial frequency of the pattern is given as the number of line pairs per mm (lp/mm or lp/cm)**

Q.17)

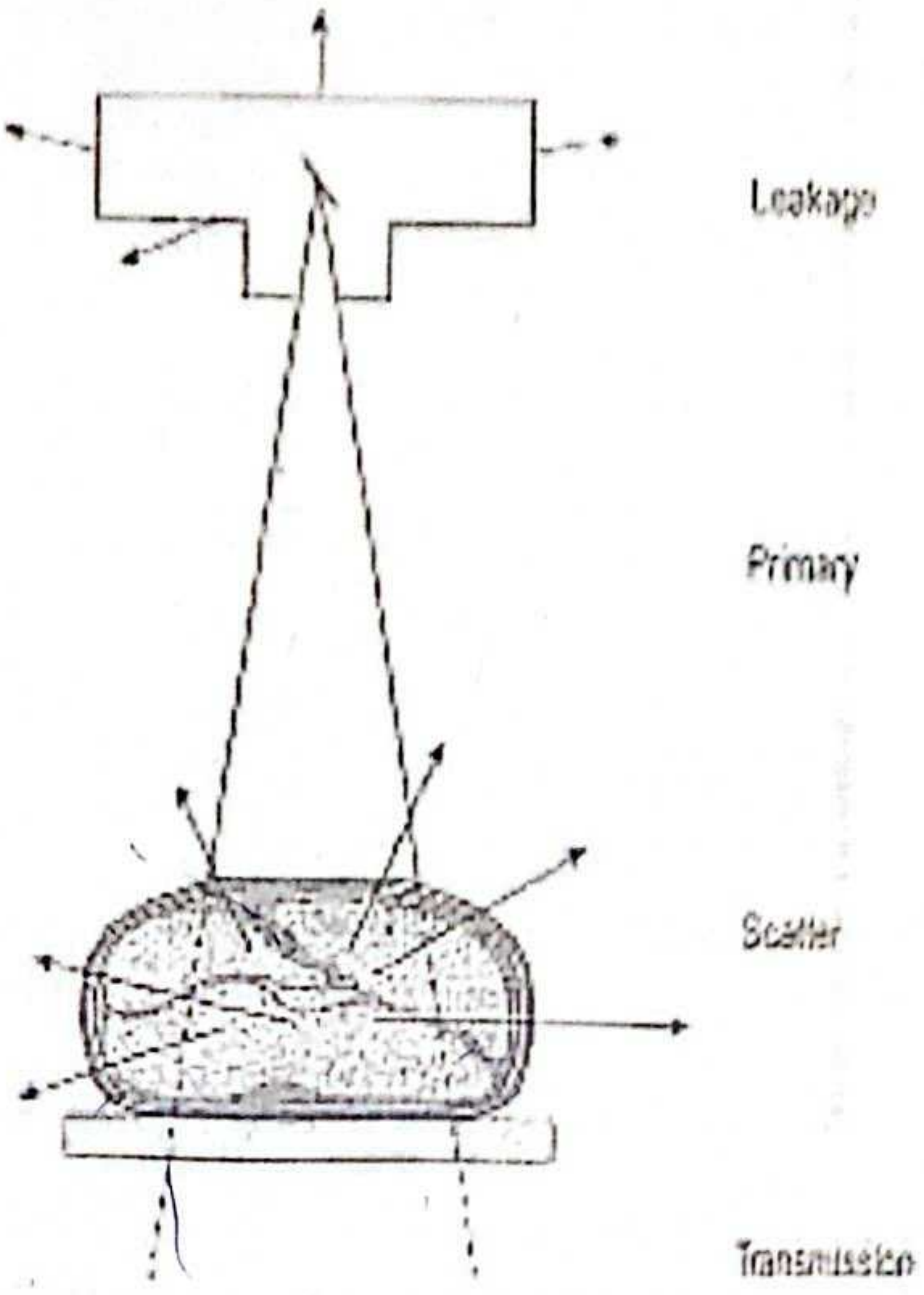
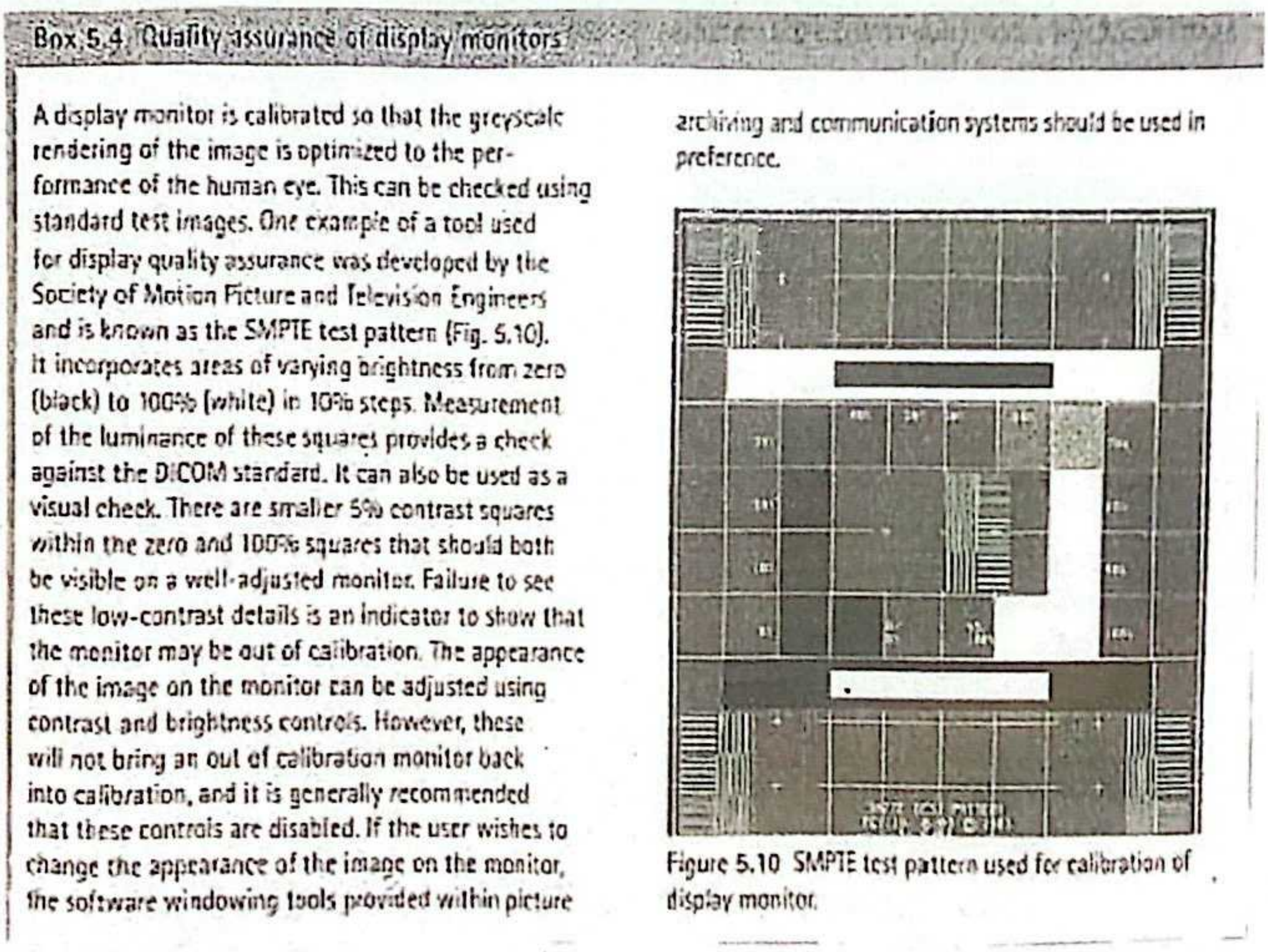


Figure 2.5 Radiation sources in the X-ray room.



Box 5.4 Quality assurance of display monitors

A display monitor is calibrated so that the greyscale rendering of the image is optimized to the performance of the human eye. This can be checked using standard test images. One example of a tool used for display quality assurance was developed by the Society of Motion Picture and Television Engineers and is known as the SMPTE test pattern (Fig. 5.10). It incorporates areas of varying brightness from zero (black) to 100% (white) in 10% steps. Measurement of the luminance of these squares provides a check against the DICOM standard. It can also be used as a visual check. There are smaller 5% contrast squares within the zero and 100% squares that should both be visible on a well-adjusted monitor. Failure to see these low-contrast details is an indicator to show that the monitor may be out of calibration. The appearance of the image on the monitor can be adjusted using contrast and brightness controls. However, these will not bring an out of calibration monitor back into calibration, and it is generally recommended that these controls are disabled. If the user wishes to change the appearance of the image on the monitor, the software windowing tools provided within picture archiving and communication systems should be used in preference.

Figure 5.10 SMPTE test pattern used for calibration of display monitor.

Name the structure?

Society of Motion Pictures and Television Engineers SMPTE test pattern

Its purpose?

Use for calibration of display monitor

What is the standard for interchange of text data?

DICOM (Digital imaging and communication in medicine)

Box 6.3 A test object for assessment of low-contrast resolution

The layout of details in Leeds test object TO.10, which is used for assessing low-contrast resolution, is shown in Figure 6.6. It incorporates 12 groups of circular details, with the diameter of each group varying from 0.25 to 11.1 mm. Each group comprises nine disks with thickness (and thus contrast) varying progressively. The system is generally used to test fluoroscopy images using 1–2 mm of copper filtration to drive the kilovoltage (kV) up to about 70 kV. Under these conditions, it is generally not possible to see more than about six details in each group, and possibly no more than one detail in the group with the smallest detail diameter. The test object is provided with calibrated contrast data enabling the user to determine the minimum visible or threshold contrast (C_T) for each detail size. From this, the threshold detection index $H_T(A)$ can be derived:

$$H_T(A) = [C_T(A) \times A^{1/2}]^{-1}.$$

Plotting $H_T(A)$ against $A^{1/2}$ provides a good indication of imaging performance and allows comparison with previous tests or with a standard as is shown in Figure 6.7.

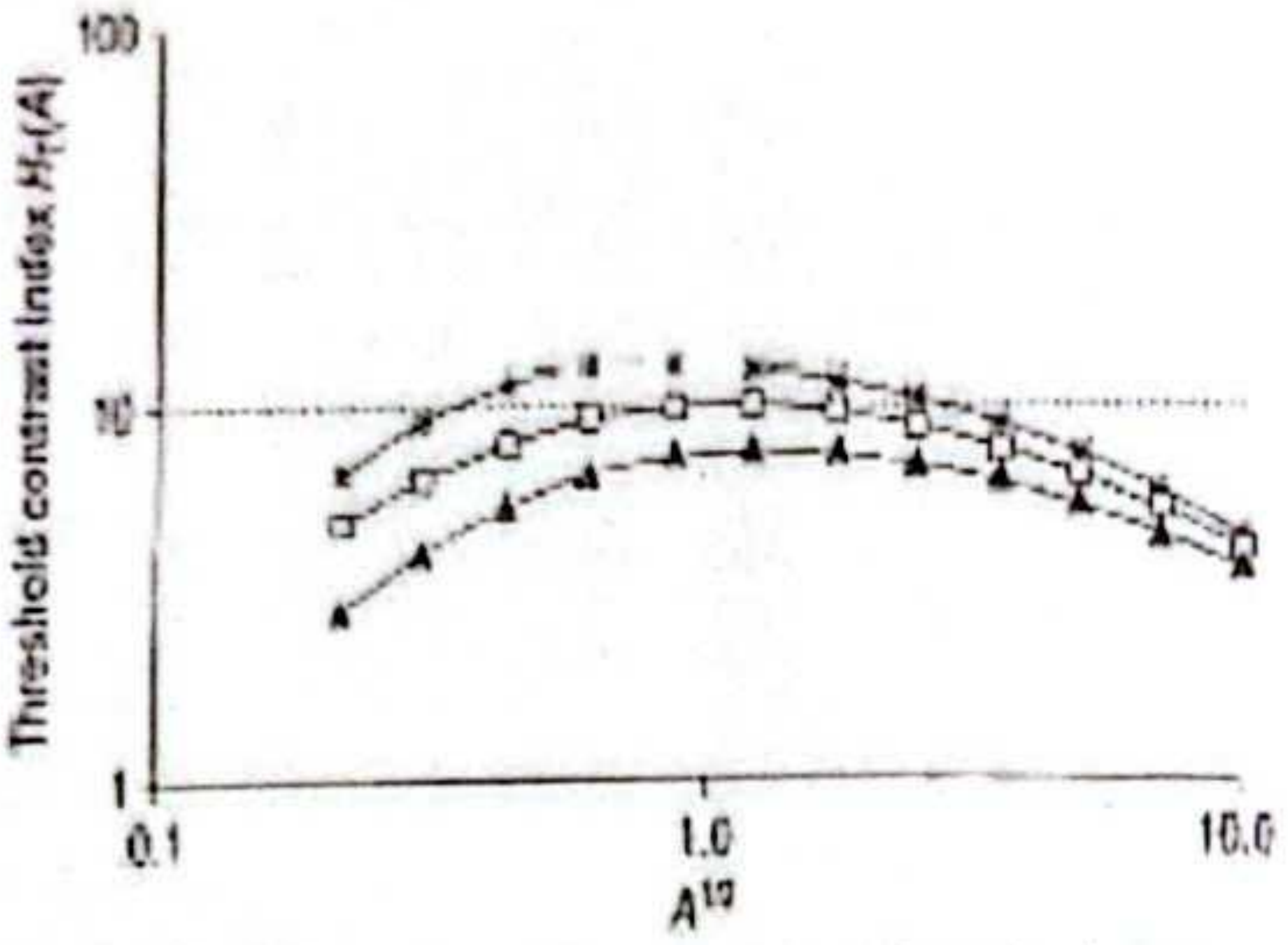


Figure 6.7 Contrast detail diagram derived from Leeds test object TO.10

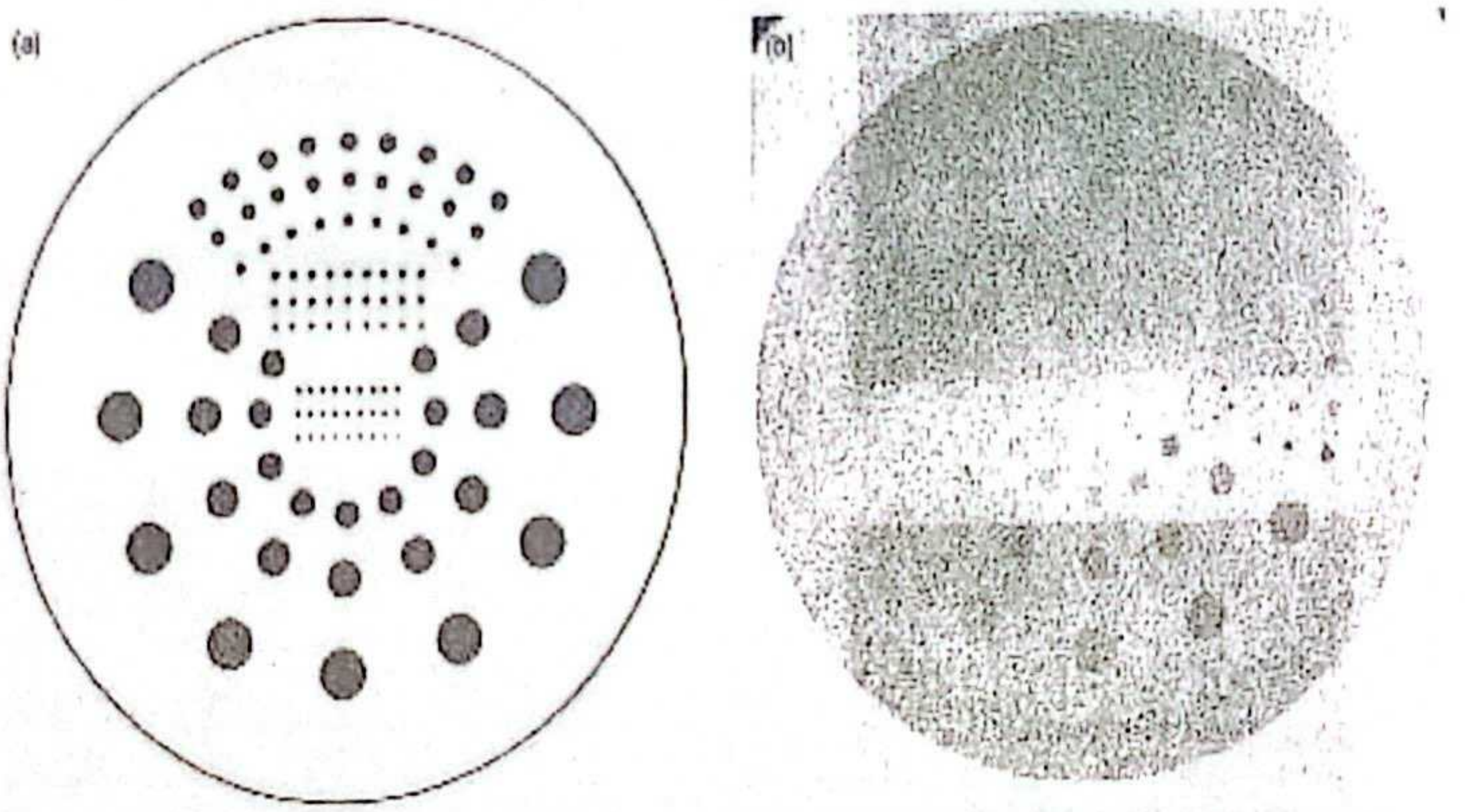


Figure 6.6 Details in Leeds test object TO.10: (a) the layout of the 12 sets of details, and (b) a simulated fluorography to show the varying levels of contrast

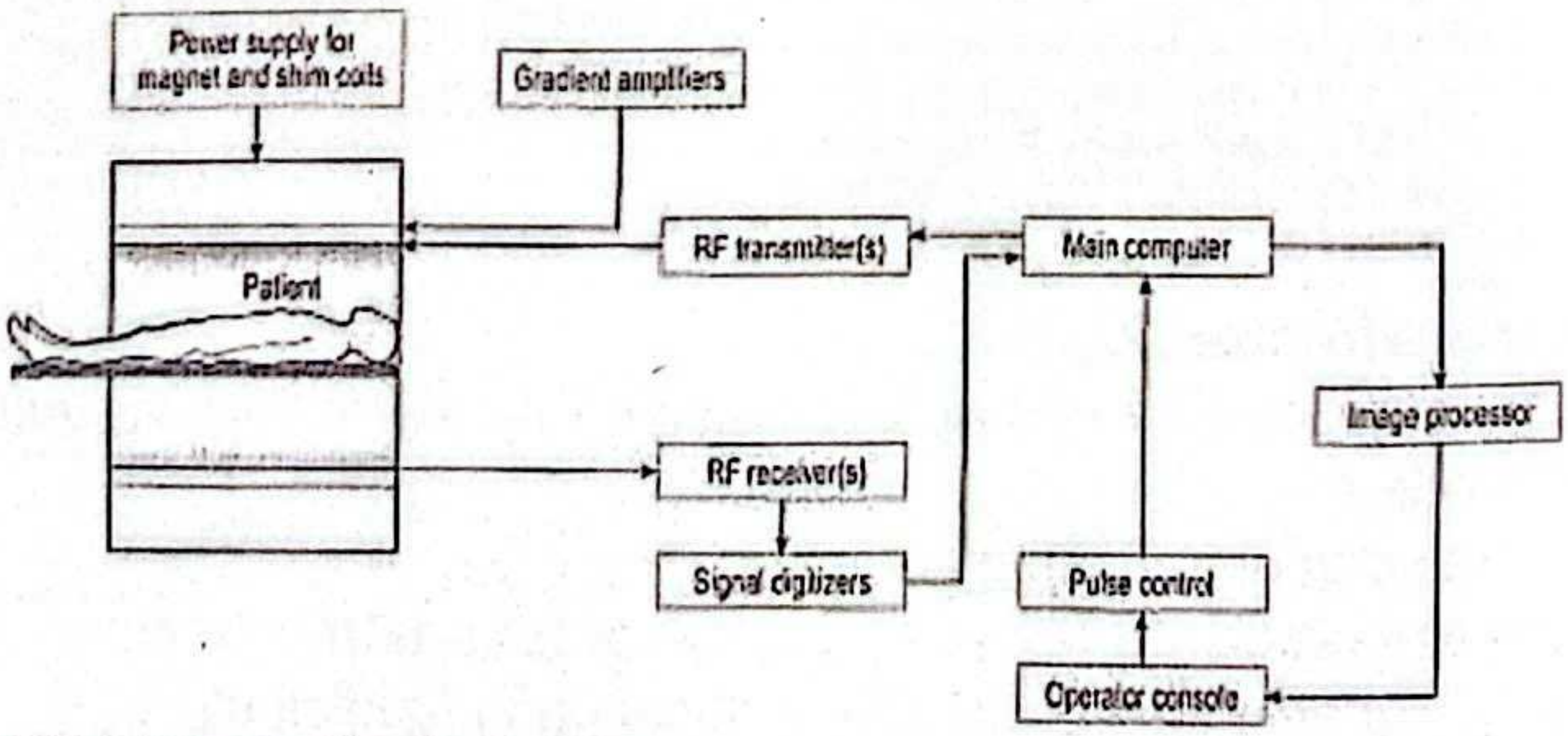

Power supply for magnet and shim coils
Gradient amplifiers
Patient
RF transmitter(s)
Main computer
Image processor
RF receiver(s)
Signal digitizers
Pulse control
Operator console

Figure 10.28 Typical system configuration. RF, radiofrequency.

Q.18)

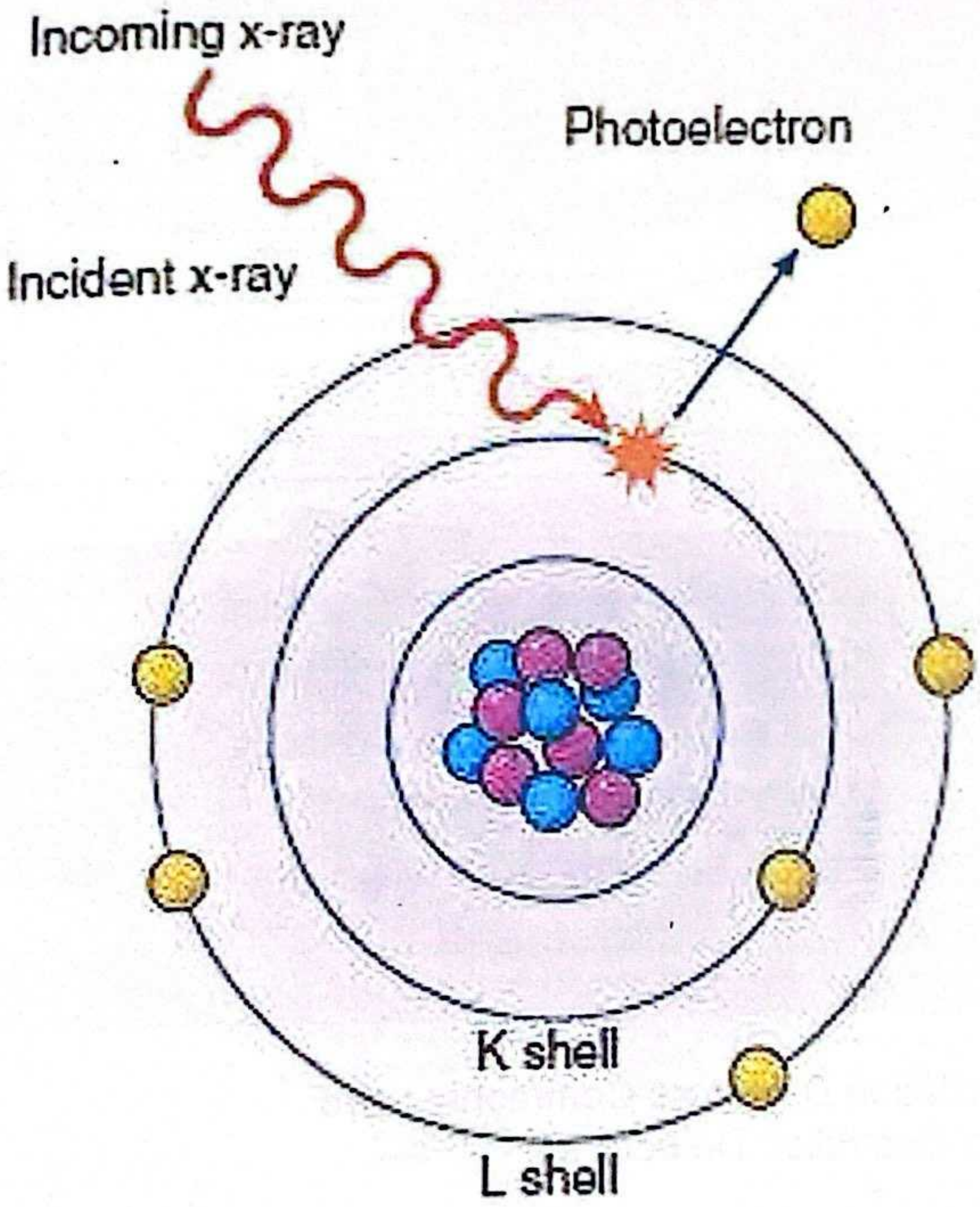
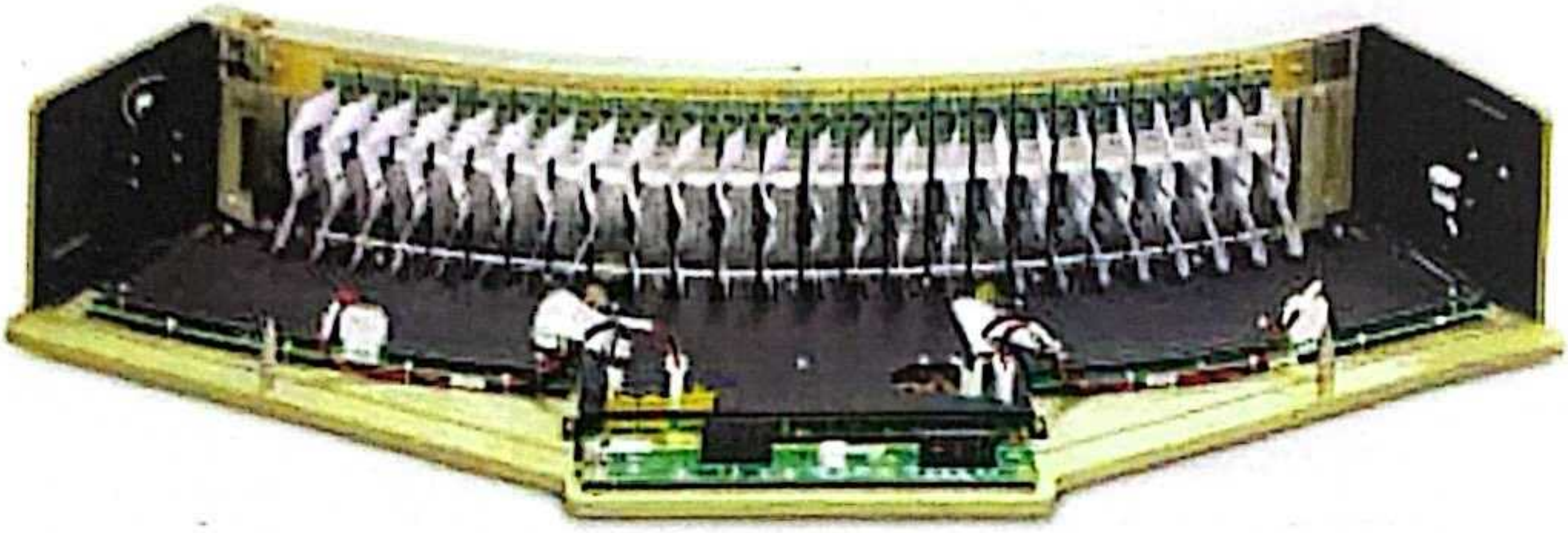

Incoming x-ray
Photoelectron
Incident x-ray
K shell
L shell

Figure 7.5. The photoelectric effect.

Attenuation process:
Absorption: Photoelectric
Scatter: Compton

- **Atomic number:** No effect on Compton
- Compton inversely proportion to **Energy**

Q.19)

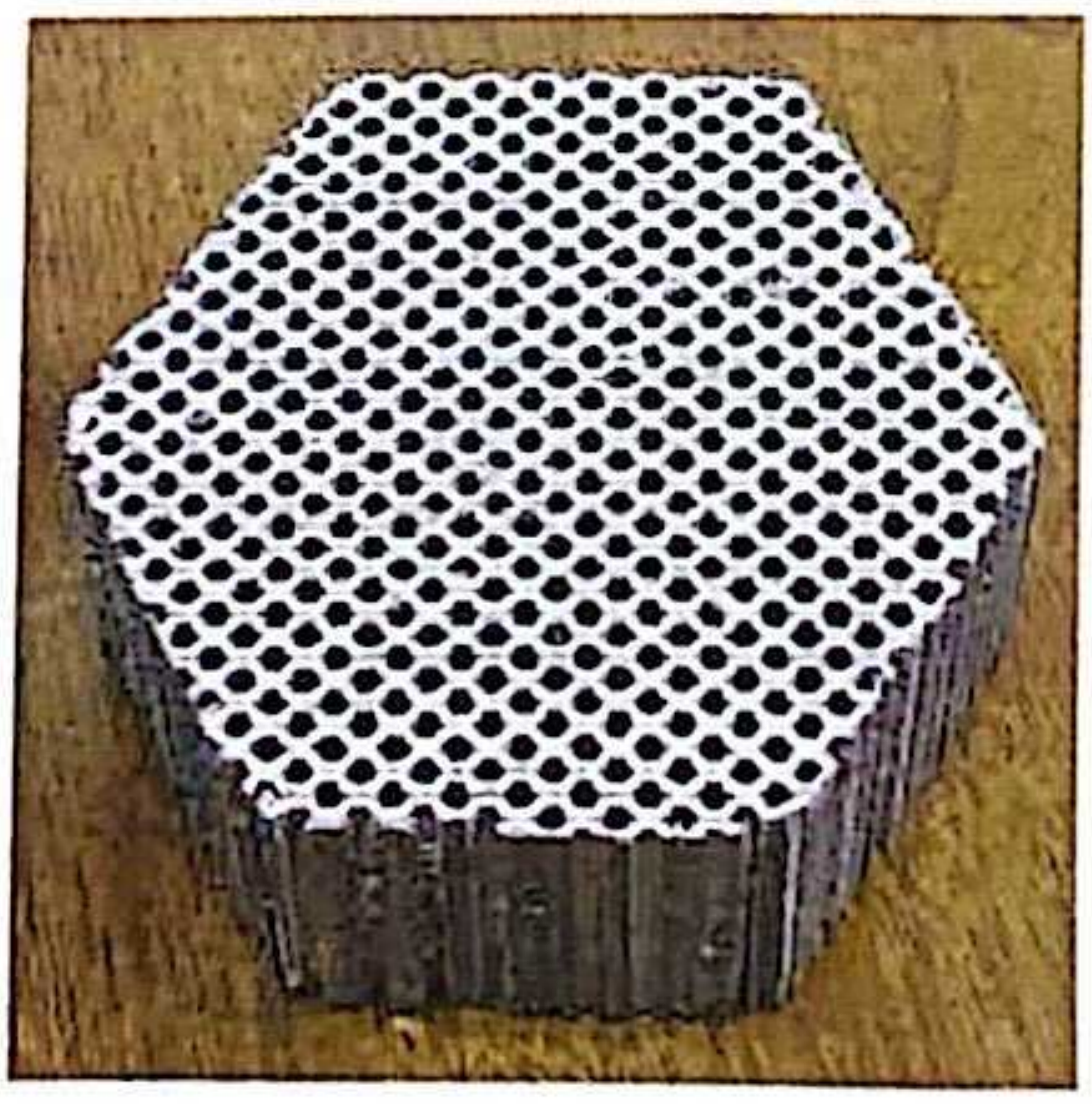


CT Detectors
Types:

1. Scintillation Detectors-Commonly used
2. Xeon Gas Filled Detectors

Most common method image reconstruction:

- Filtered back projection

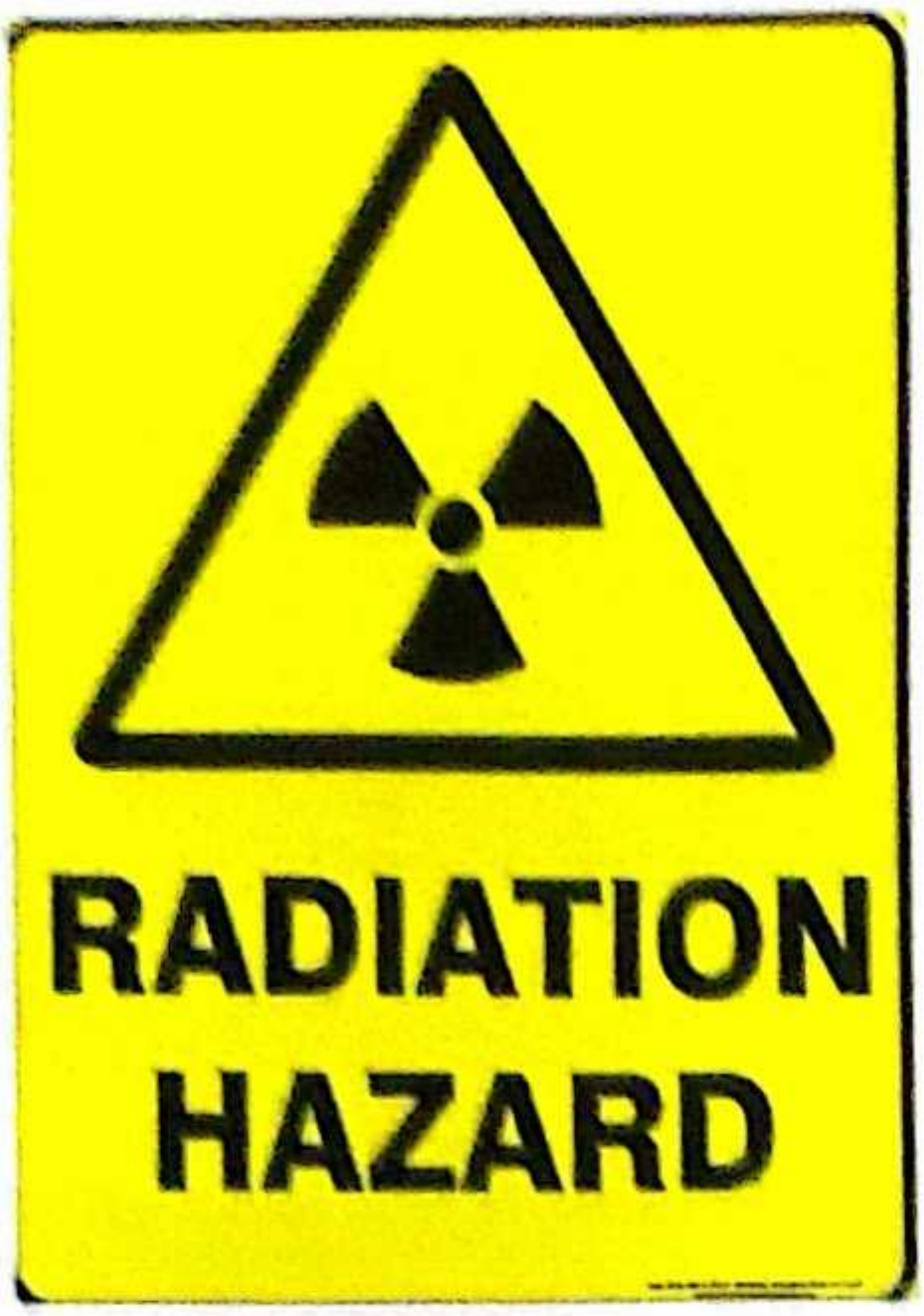


Gamma Camera Collimator

- Large FOV 500mm- Bone Scan Gallium Scan
- Mobile Gama Camera- Cardiac imaging- 250mm FOV
- General-Tc99-400mm FOV

RADIATION

Q.1) (2017)



Name the short term effects of radiation exposure S n

1. Nausea
2. Vomiting
3. Deaarranged blood cell count
4. Nervous breakdown
5. Skin erythma

Deterministic Non

1. Appear above a given threshold
2. The severity of the effect increases with dose
3. Effects occur within days of the exposure
4. Includes tissue effects e.g. erythema

Stochastic

1. No threshold to effects
2. The probability of the effect increases with the dose
3. Effects may happen years after exposure
4. Includes only cancer and genetic mutations

Exposed tissue	Net effect	Absorbed dose required for effect (Gy)	Time for effect to develop
Skin	Initial erythema	2	2-24 hours
	Erythema	3-6	1-4 weeks
	Hair-loss	3-4	2-3 weeks
Lens of eye	Cataract	3-5	Years
Bone marrow	Depression of blood formation	0.5	3-7 days
Gonads	Temporary sterility in males	0.15	3-9 weeks
	Permanent sterility	3.5-6	3 weeks

Justification
Ionizing radiations should not be used unless it can be demonstrated that the benefit exceeds the risk to those who are liable to be exposed.

Quality control is the measurement/instrumentation and evaluation of equipment to maintain superior standards

A program of QA monitors proper patient scheduling, reception, and preparation

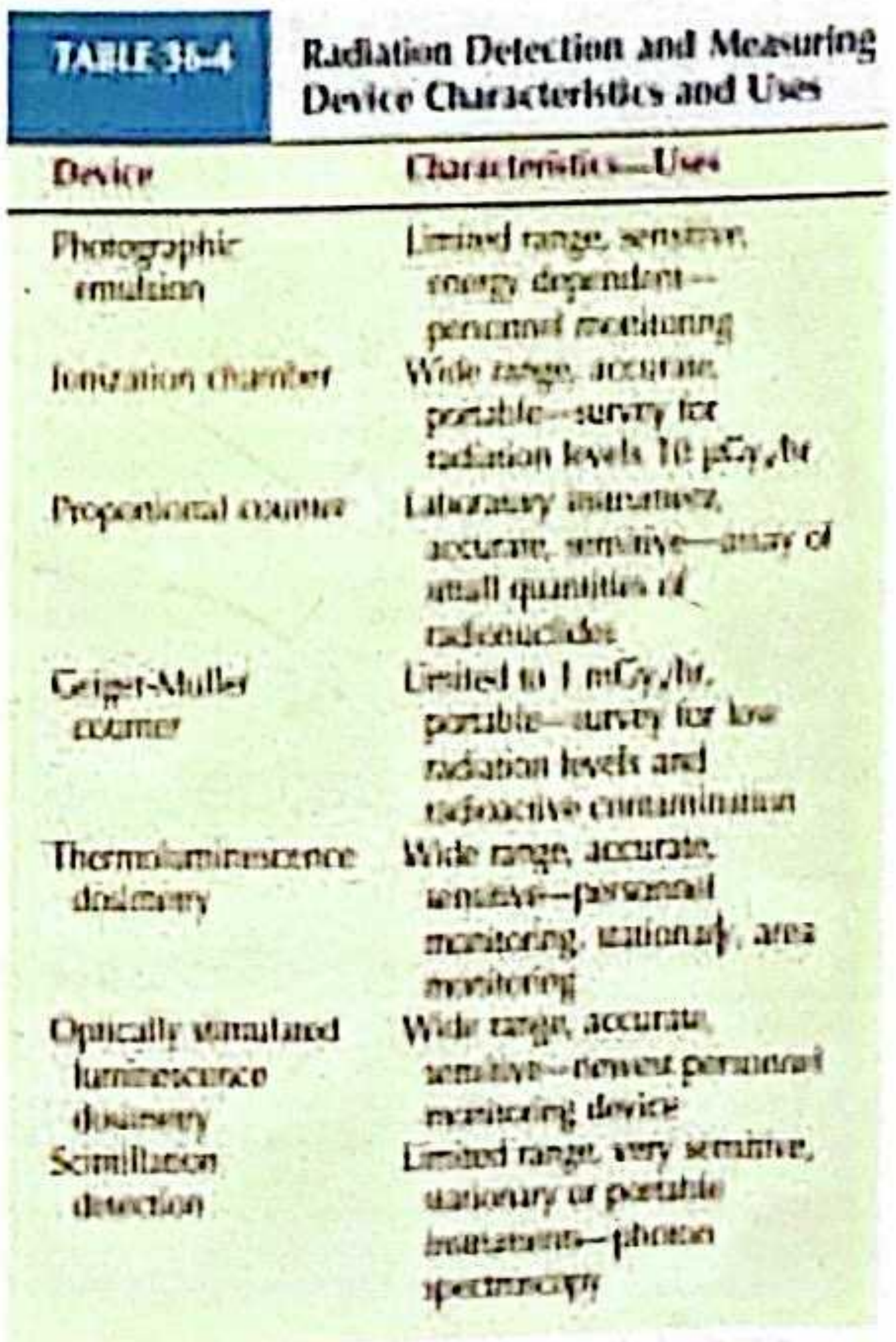
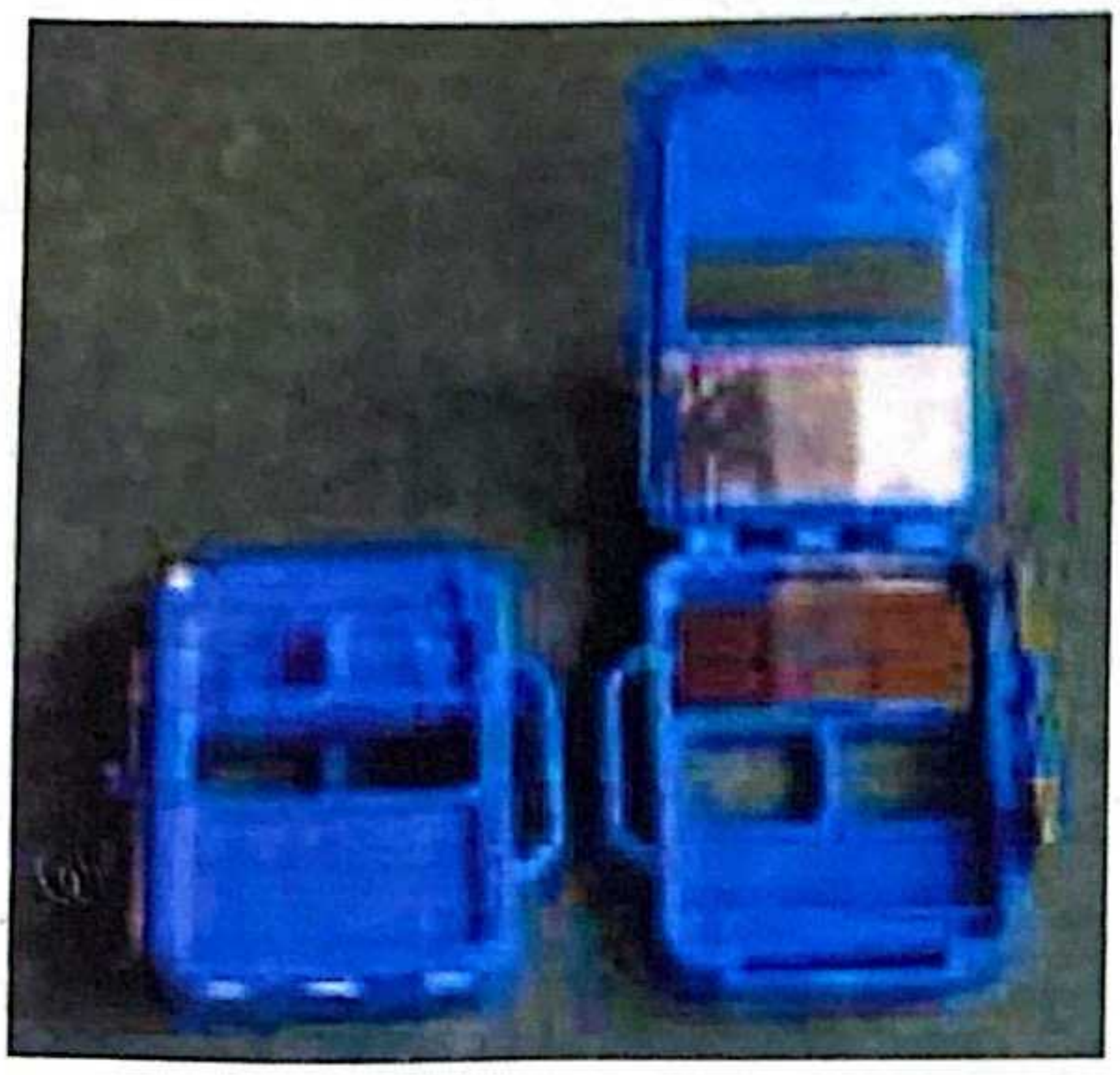
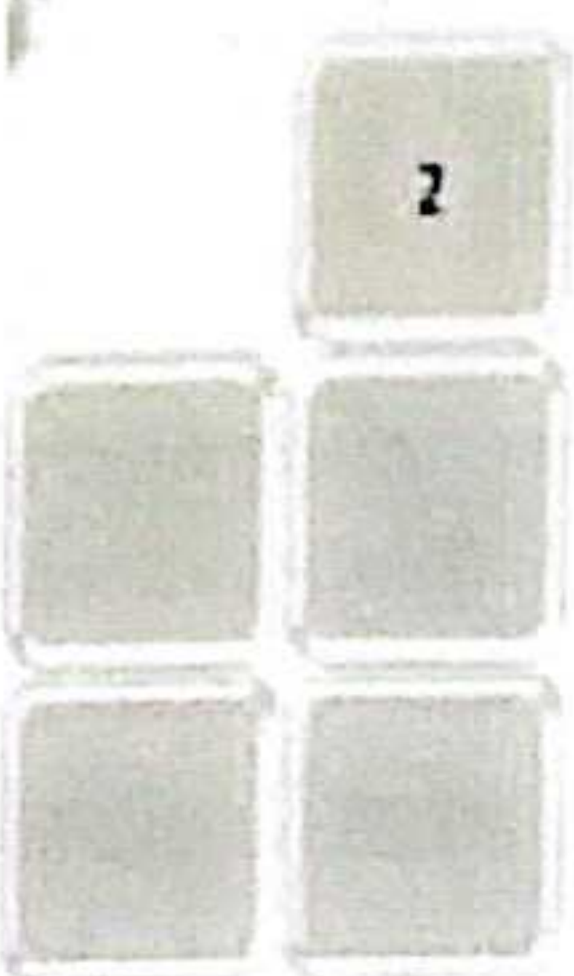


TABLE 36-4 Radiation Detection and Measuring Device Characteristics and Uses

Device	Characteristics—Uses
Photographic emulsion	Limited range, sensitive, energy dependent—personnel monitoring
Ionization chamber	Wide range, accurate, portable—survey for radiation levels 10 μGy/hr
Proportional counter	Laboratory instrument, accurate, sensitive—assay of small quantities of radionuclides
Geiger-Muller counter	Limited to 1 mGy/hr, portable—survey for low radiation levels and radioactive contamination
Thermoluminescence dosimetry	Wide range, accurate, sensitive—personnel monitoring, stationary, area monitoring
Optically stimulated luminescence dosimetry	Wide range, accurate, sensitive—newest personnel monitoring device
Scintillation detection	Limited range, very sensitive, stationary or portable instruments—photon spectroscopy

Q.2) **(2017), (2015)**



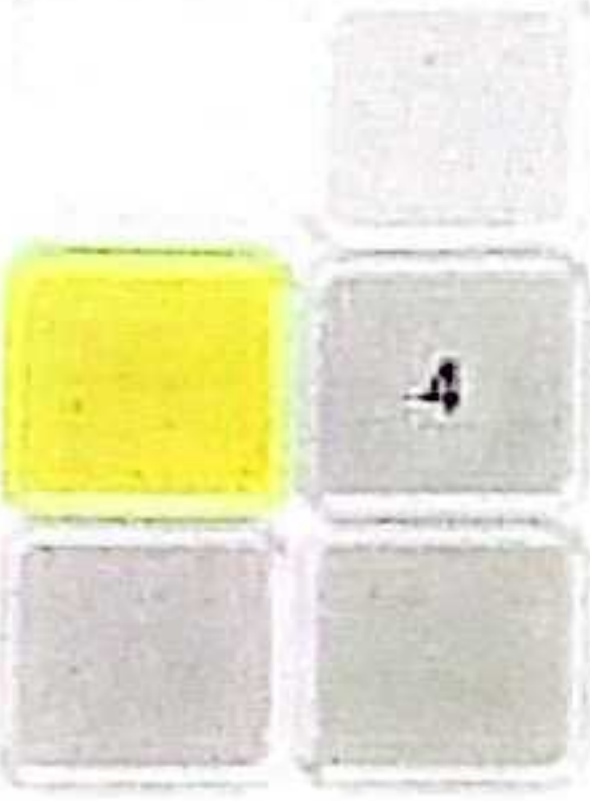


1 First Window

- Without any filter
- It detects α (alpha) particles
- Due to minimum penetration power of alpha particles no metallic filter is used

2 Second Window

- Filter is made of Plastic
- Light white colour
- It detects β (beta) particles
- Thickness of filter : 1 mm

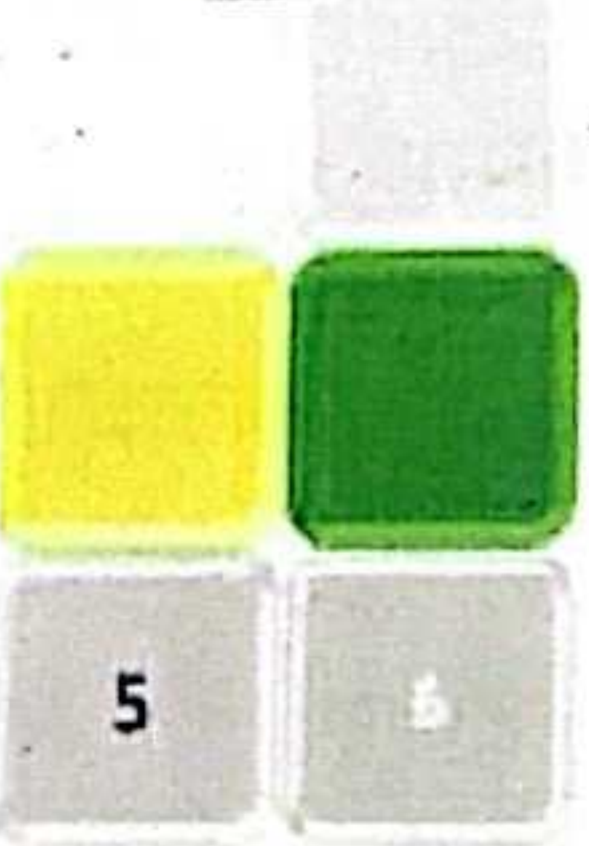


3 Third Window

- Filter is made of Cadmium
- Yellow in colour
- It detects Thermal Neutrons
- Thickness of filter: 1mm

4 Fourth Window

- Filter is made of thin copper
- Green in colour
- It detects low energy X-rays
- Thickness of filter :0.15 mm



5Fifth Window

- ~~Filter is made of thick copper~~
- Pink in colour
- It detects High Energy X-Rays
- Thickness of filter : 1 mm

6 Sixth Window

- Filter is made of Lead
- Black in colour
- It detects γ (gamma) rays
- Thickness of filter : 1mm

A dosimeter can be defined generally as any device that is capable of providing a reading that is a measure of the absorbed dose D, deposited in its sensitive volume V by ionizing radiation.

Identify

- Film Badge

Where should it be worn?

- Behind Lead Apron

Total effective annual dose of radiation worker?

- 20 mSv ✓

Pregnanacy worker effective annual dose?

- 50mSv ✓ 80

Film Badge is of two types

- ✓ Chest badge
- ✓ Extremity badge

Minimum dose that can be detected by film badge is

- 0.2 mSv ✓

Range of film badge is

- 10 KeV to 2 MeV

Advantages:

1. It gives permanent record
2. Wide exposure range
3. Independent of dose rate
4. Type of radiation and energy can be evaluated
5. Least expensive device
6. Small, light weight, easy to handle

Disadvantages:

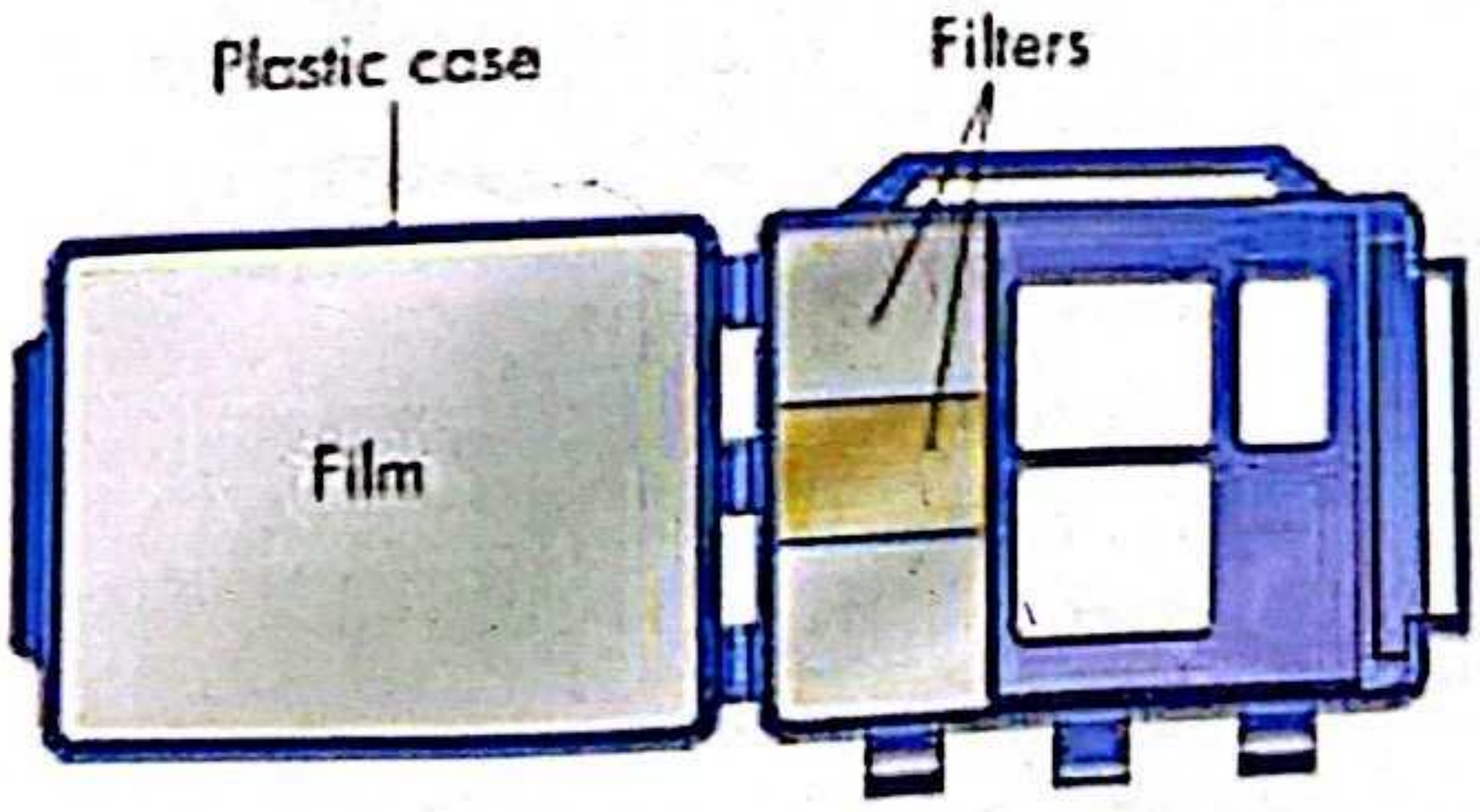
1. Cant give instantaneous reading
2. It's film fades at high temperature and humidity
3. High sensitivity to light, pressure and chemicals
4. Complete dark room procedure
5. Limited shelf life (one month)

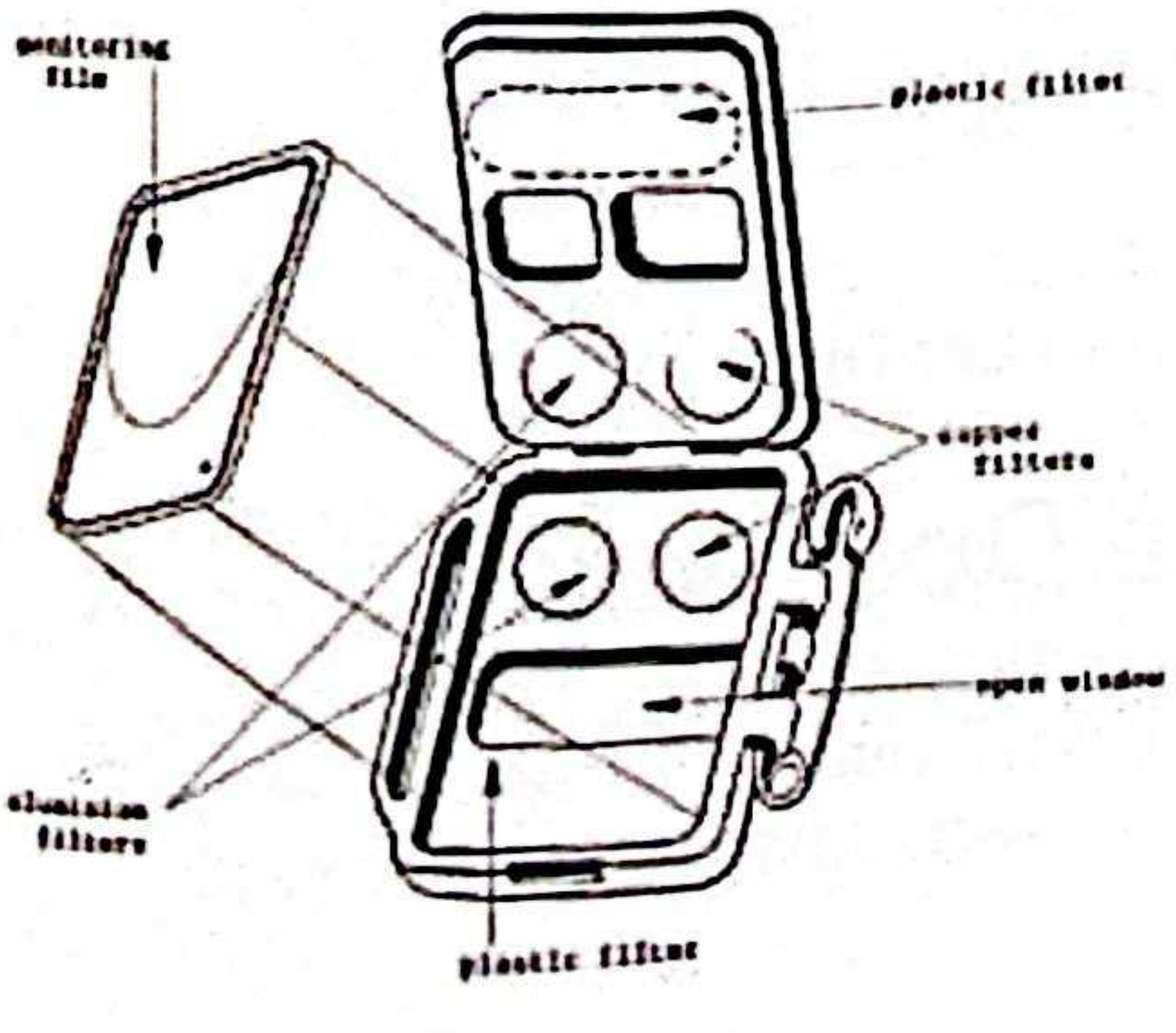
Absolute dosimeters

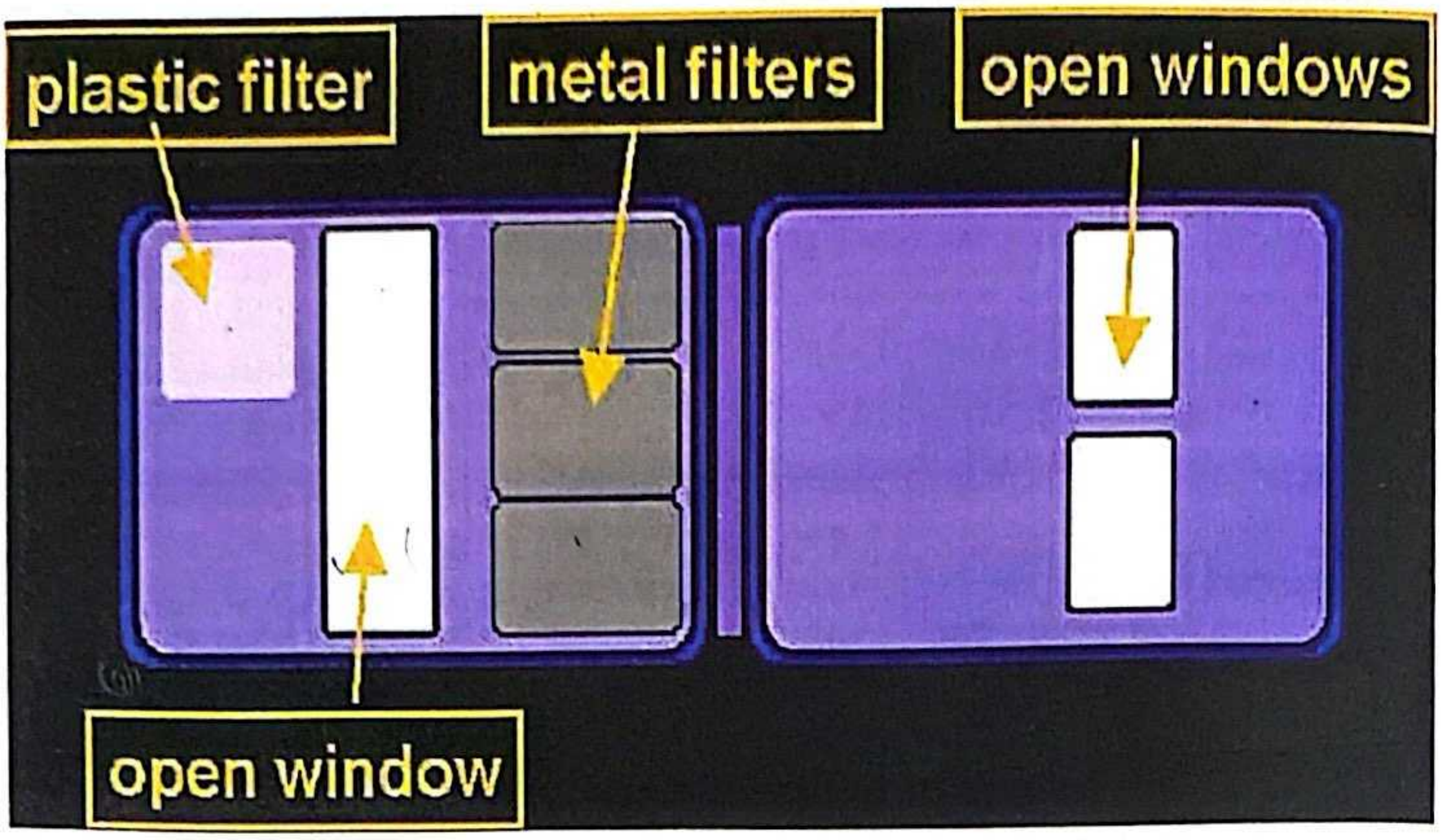
- The dose is determined without reference to another dosimeter.
- Example: free air ionization chamber, specially designed spherical chambers of known volume, calorimeter, Fricke dosimeter.

Secondary dosimeters

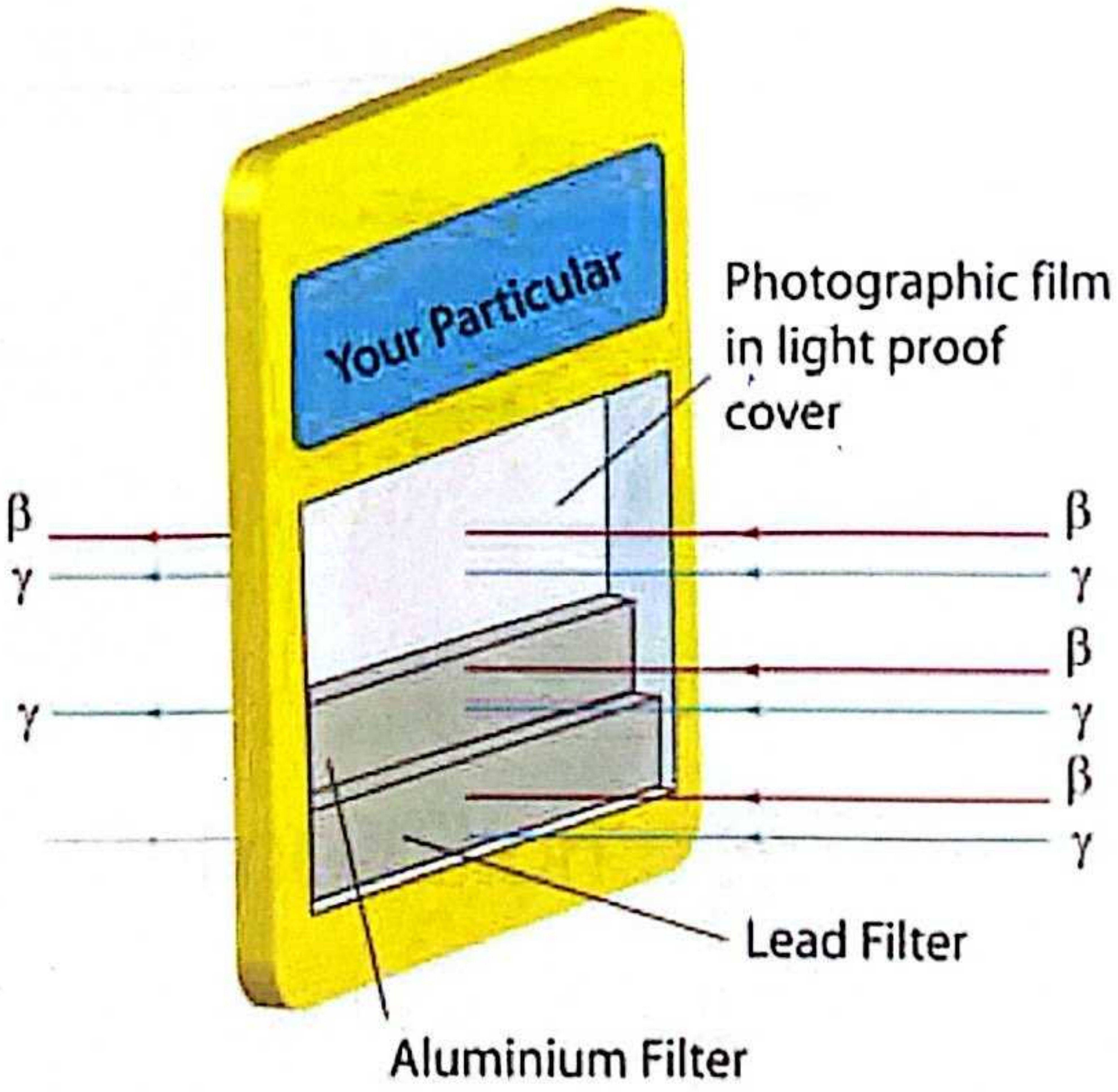
- These dosimeters requires calibration against a primary standard.
- Example: thimble chambers, plane parallel ion chambers, TLD's, Diodes and Films.


Plastic case
Filters
Film


monitoring film
plastic filter
copper filters
open window
aluminium filters
plastic filter


plastic filter
metal filters
open windows
open window

detects beta, gamma, X Ray


Your Particular
Photographic film in light proof cover
β
γ
γ
β
γ
β
γ
β
γ
Lead Filter
Aluminium Filter

Film Badge Dosimeter

Q.3) **(2017)**

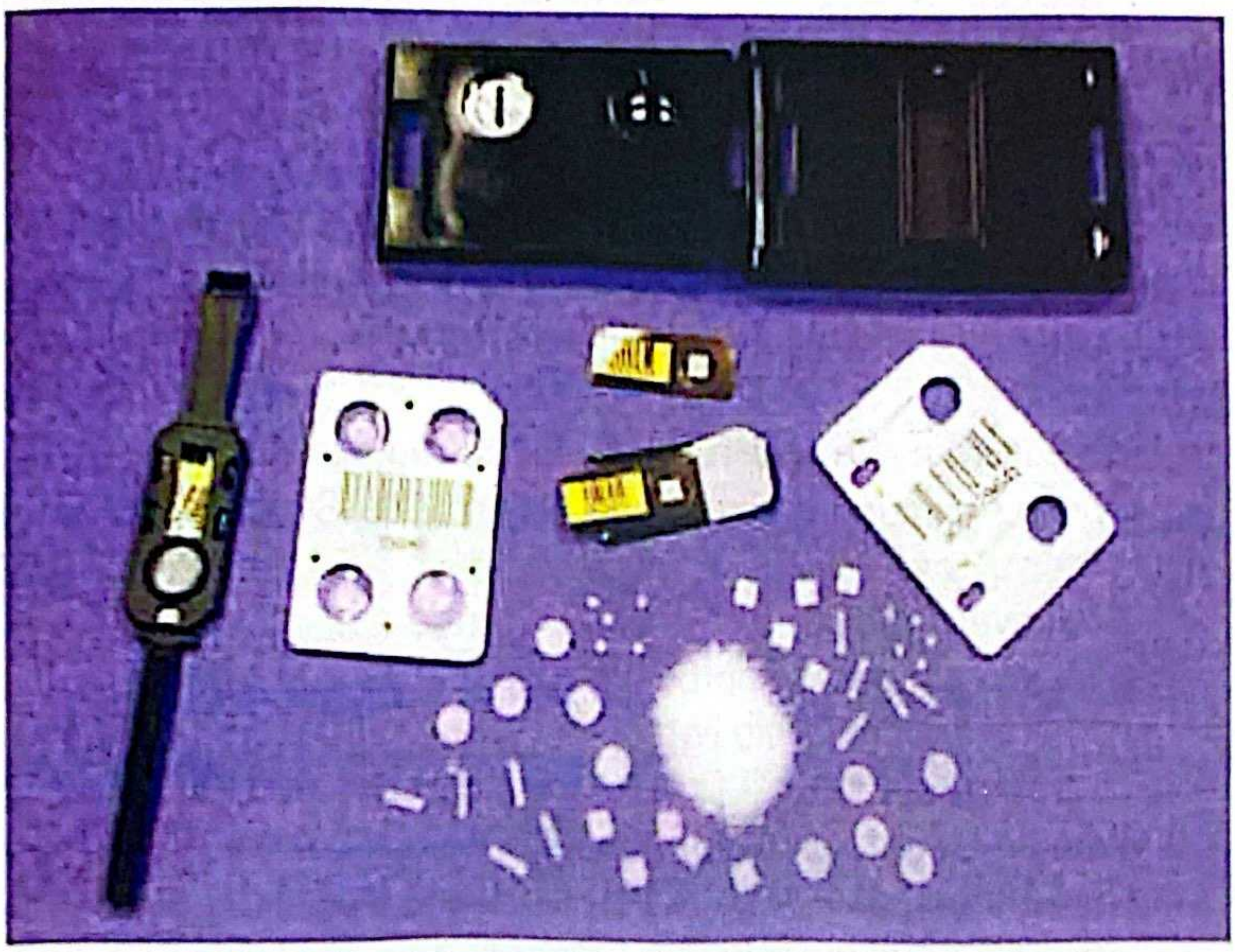
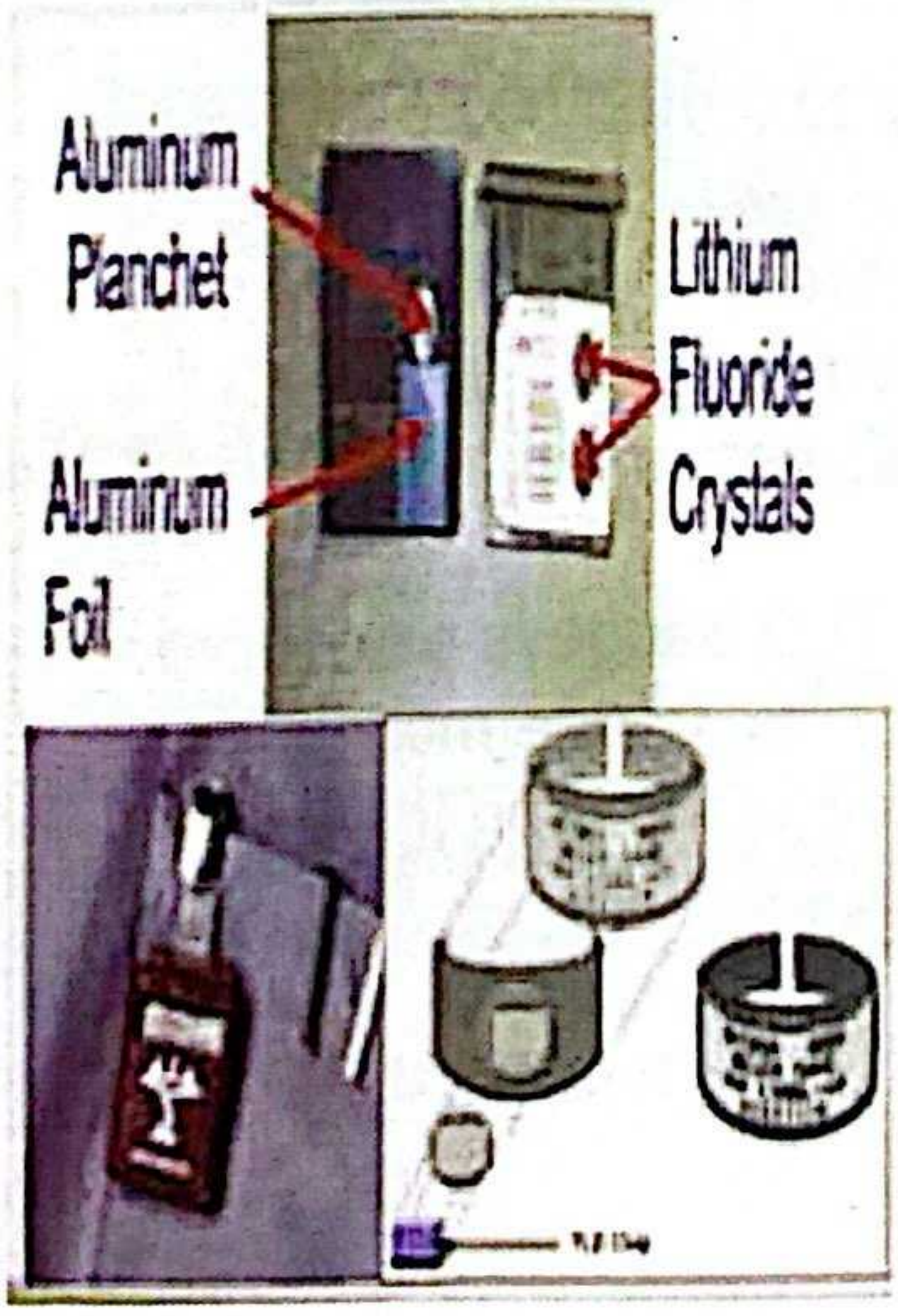


FIGURE 38-5 Thermoluminescence dosimeters are available as chips, discs, rods, and powder. These are used for area and environmental radiation monitoring, and especially for occupational radiation monitoring. (Courtesy Bicron.)


Aluminum Planchet
Aluminum Foil
Lithium Fluoride Crystals

- These detectors utilise the electron trapping process.
- One of the most common materials is lithium fluoride and dysprosium doped calcium sulphate ($CaSo_4$: Dy) which is selected because after irradiation electrons in the crystal matrix are raised to a metastable excited state.

- Under normal temperatures these electrons remain in this state but heating the material to over 300°C releases them from the traps and they rapidly return to the valence band with the emission of a light photon.

There are 3 disc in TLD

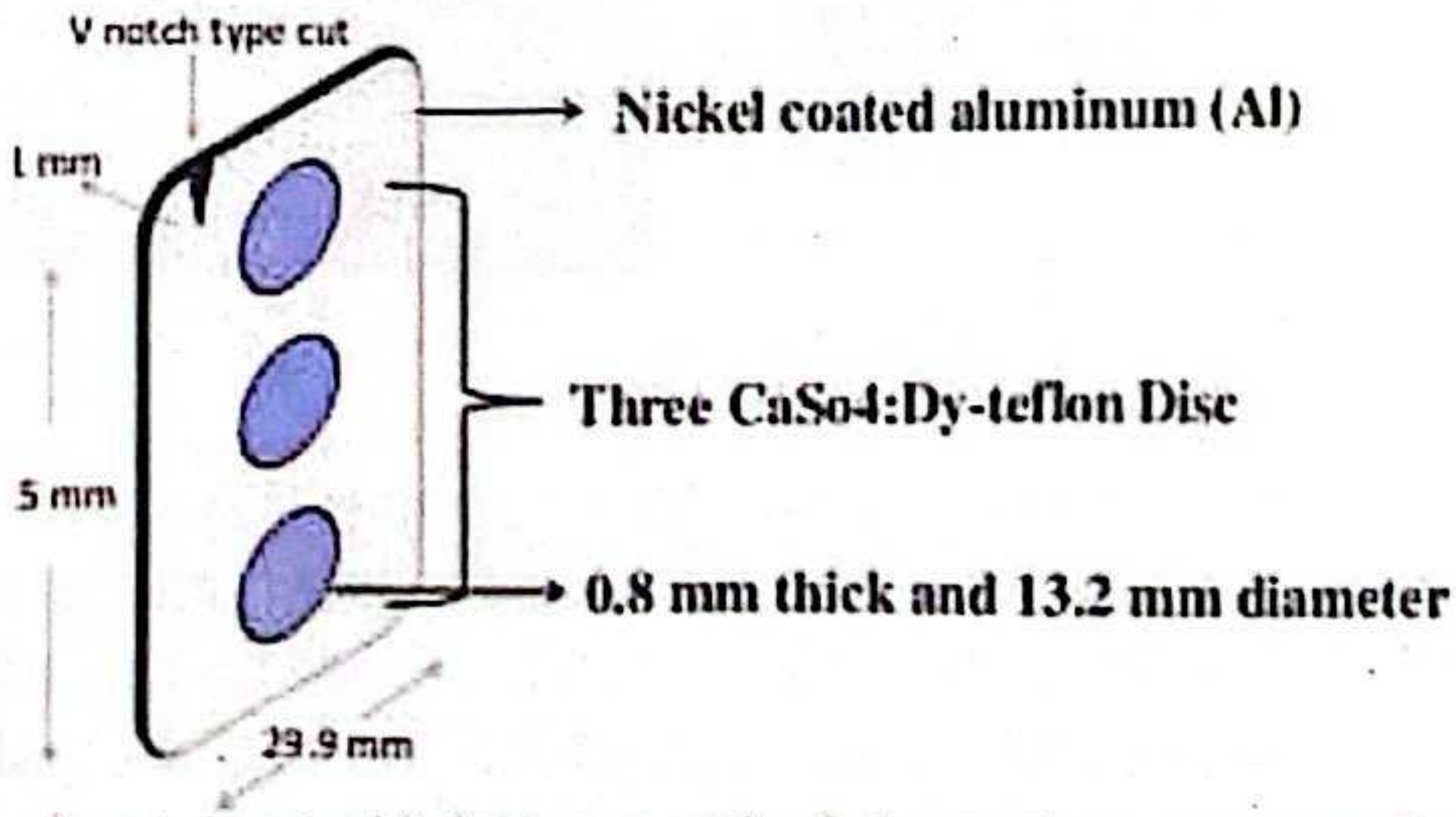
- 1st disc consist of Al and Cu combination filter window, which cut of the beta radiation and gives the TL due to the X and Gamma radiation.
- 2nd disc consist of the plastic window which cut of the soft beta radiations and records X-rays, Gamma rays and hard Beta radiations.
- 3rd disc has no filter records all the radiation.
- It can measure doses ranging from 100 uSv or 0.2mSv to 10Sv.

Advantages:

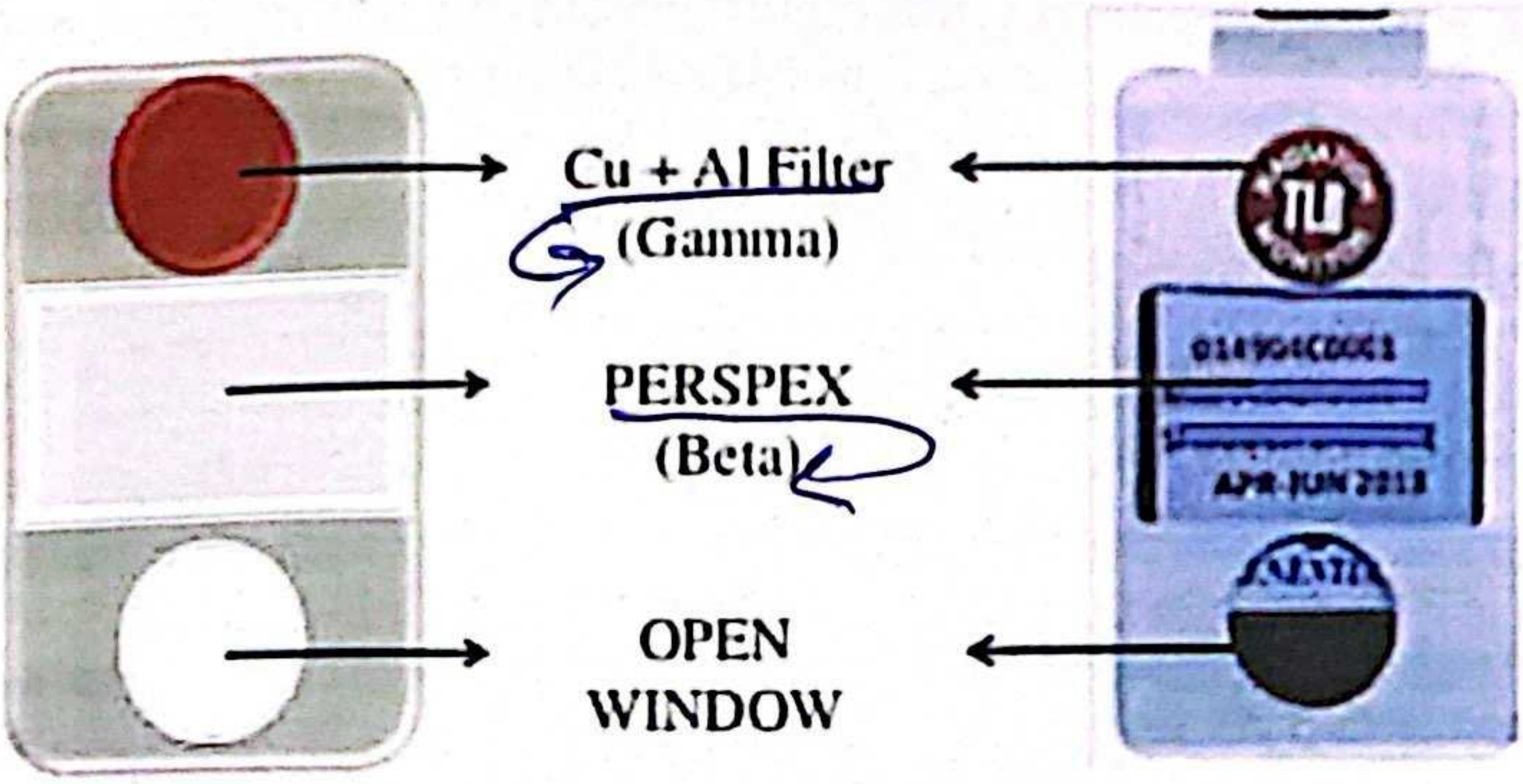
1. Relatively good energy independence
2. Atomic number is approximate tissue equivalent
3. Unaffected by visible light, moisture and mechanical vibration
4. It is reusable, one TLD card can be used 100 times, so one card can be used for 300 months (25 years)
5. It is more sensitive and more accurate than film badge and give reliable result because no fading is observed due to changes in environmental conditions
6. Properly calibrated TLD monitors can measure exposure as low as 5mR
7. Can be worn for intervals up to 3 months at a time

Disadvantages:

1. Does not provide permanent record like film Badge
2. Does not give instantaneous result
3. Primary disadvantage of TLD personnel monitoring is cost but due to reuse it is cost effective
4. Instrumentation for reading TLD badge is expensive
5. Price is perhaps twice that of film badge monitoring
6. Skilled trained experts are required to run the service

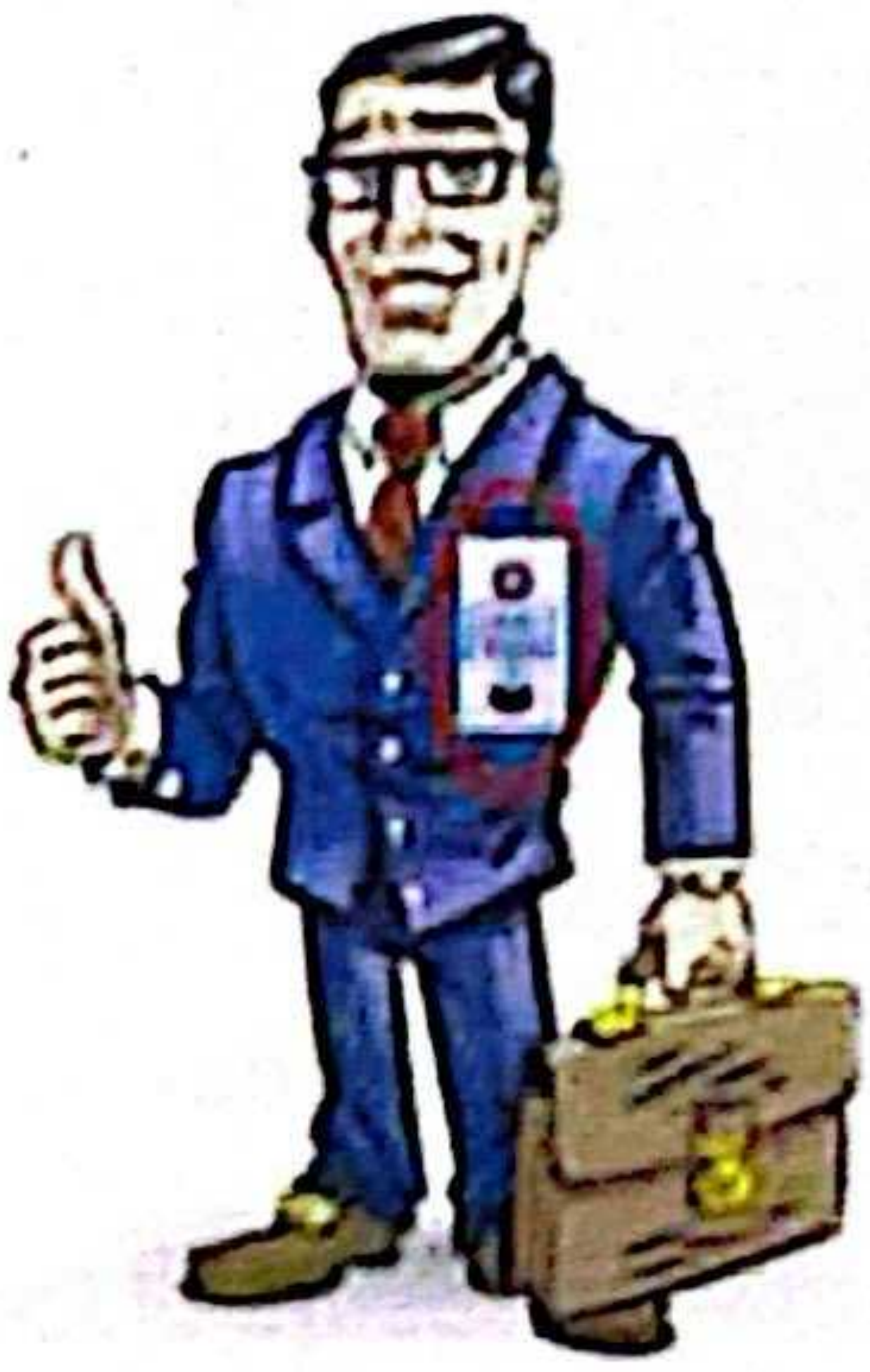

V notch type cut
Nickel coated aluminum (Al)
1 mm
Three CaSo4:Dy-teflon Disc
5 mm
0.8 mm thick and 13.2 mm diameter
29.9 mm

A cut is provided at one end of the card to ensure a fixed orientation of a card in the TLD cassette


Cu + Al Filter
(Gamma)
PERSPEX
(Beta)
OPEN
WINDOW
APR-JUN 2013

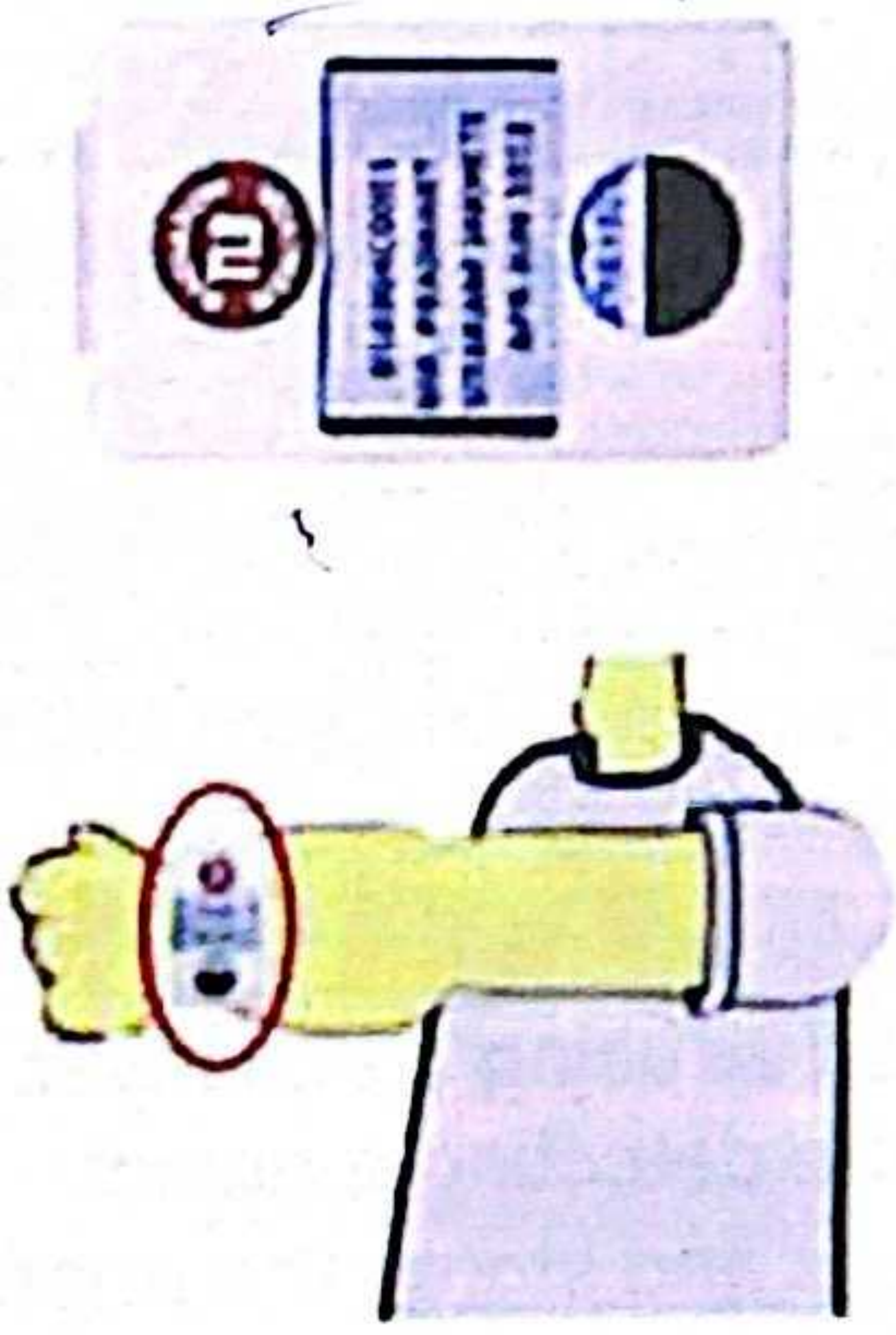
Chest Badge

Whole Body Dose



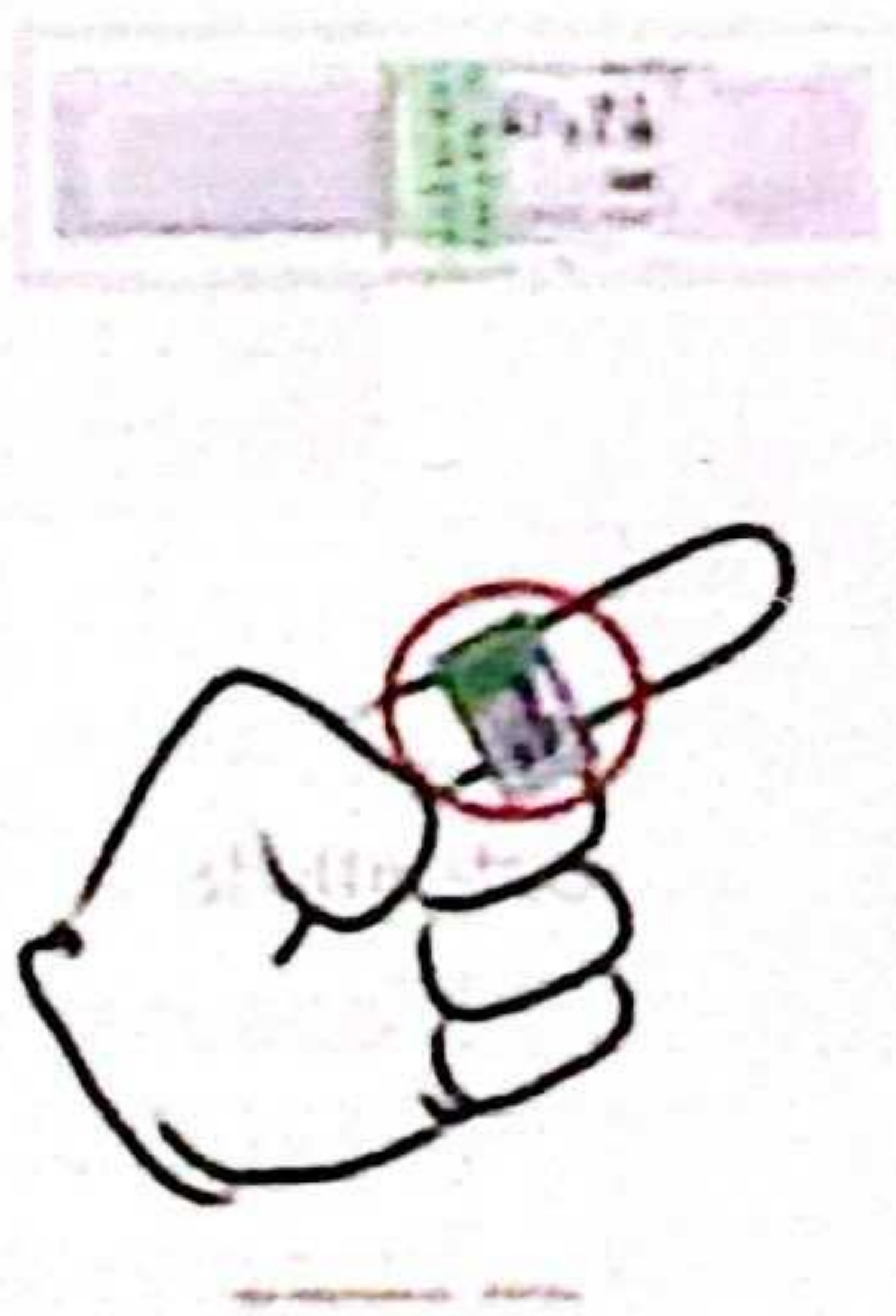
Wrist Badge

Extremity Dose



Finger Dosimeter

Finger Dose



Phosphors

	Lithium Fluoride	Lithium Borate	Calcium Fluoride	Calcium Sulfate
Composition	LiF:Mg	$LiB4O_7$:Mn	CaF_2:Mn	$CaSO_4$:Dy
Density x10^3 (kg/m^3)	2.64	2.5	3.18	2.61
Effective atomic no	8.2	7.4	16.3	15.3
Temperature of main peak	195	200	260	220
Principle use	Patient and personnel dosimeter	Research	Environmental monitoring	Personnel and environmental

Q.4) Dosimetry using Optically Stimulated Luminescence (OSL) is also available now a days alternative to TLD

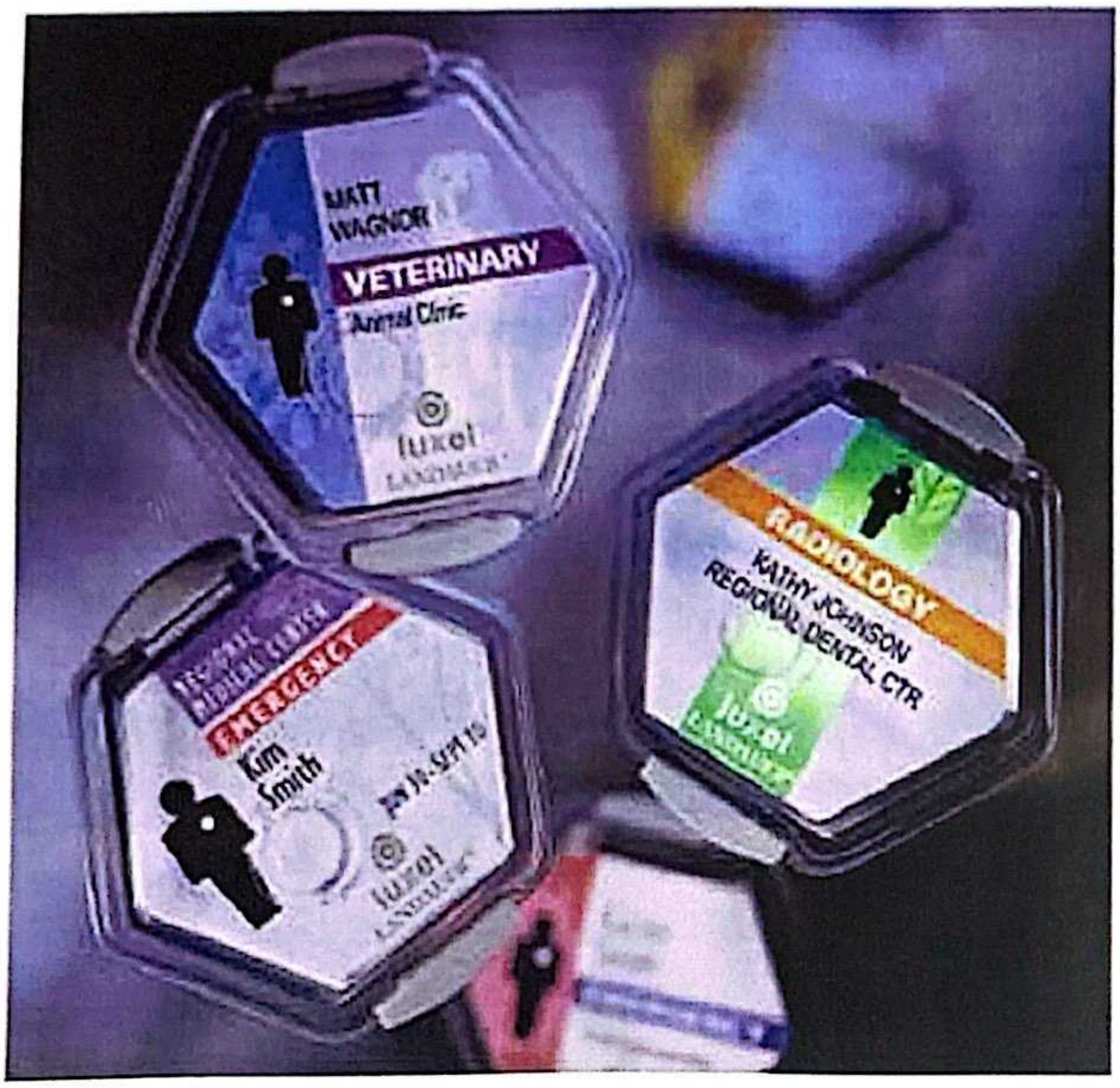
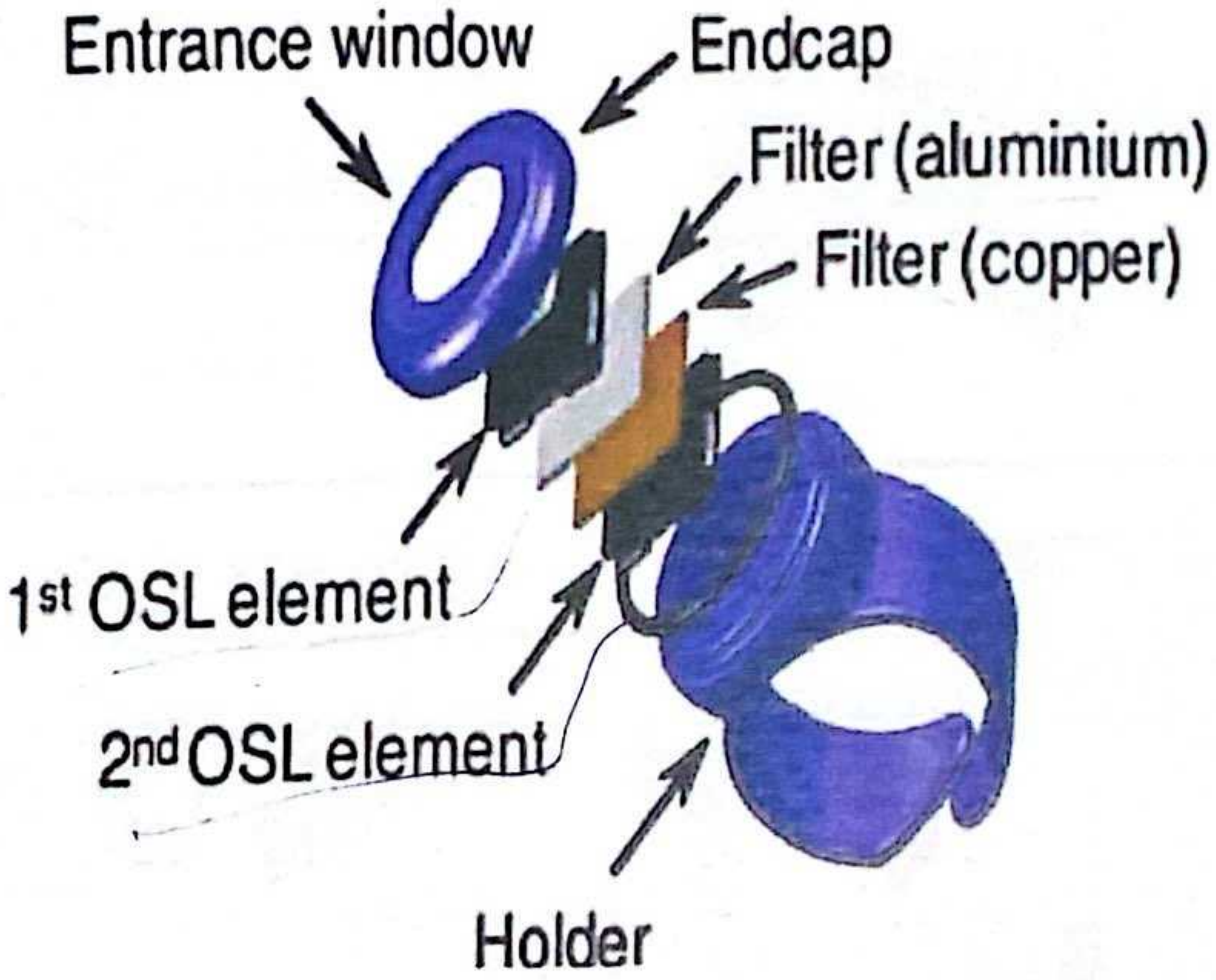

MATT WAGNOR
VETERINARY
Animal Clinic
luxel LANDAUER
RADIOLOGY
KATHY JOHNSON
REGIONAL DENTAL CTR
luxel LANDAUER
EMERGENCY
Kim Smith
luxel LANDAUER

FIGURE 38-6 Optically stimulated luminescence dosimeters. (Courtesy Landauer, Inc.)

- Measures radiation using a thin layer of aluminum oxide (A1203:C) as the detecting medium
- Tiny crystal traps and stores the energy from exposure of ionizing radiation
- Amount of exposure can be determined by shining green laser on crystal and measuring the intensity of blue light emitted
- The principle of OSL is similar to TLD except the heating
- Instead of heating, laser is used to stimulate light emission
- Small, lightweight, fast and efficient service
- Minimum reportable level is 10 uSv for both x-rays and gamma radiation
- Range of OSL is from 5 keV to 40 Me V.
- wide dose range : from 10uSv to 10Sv.
- OSL Dosimeter can be used several times.


Entrance window
Endcap
Filter (aluminium)
Filter (copper)
1st OSL element
2nd OSL element
Holder

Optically Stimulated Luminescence

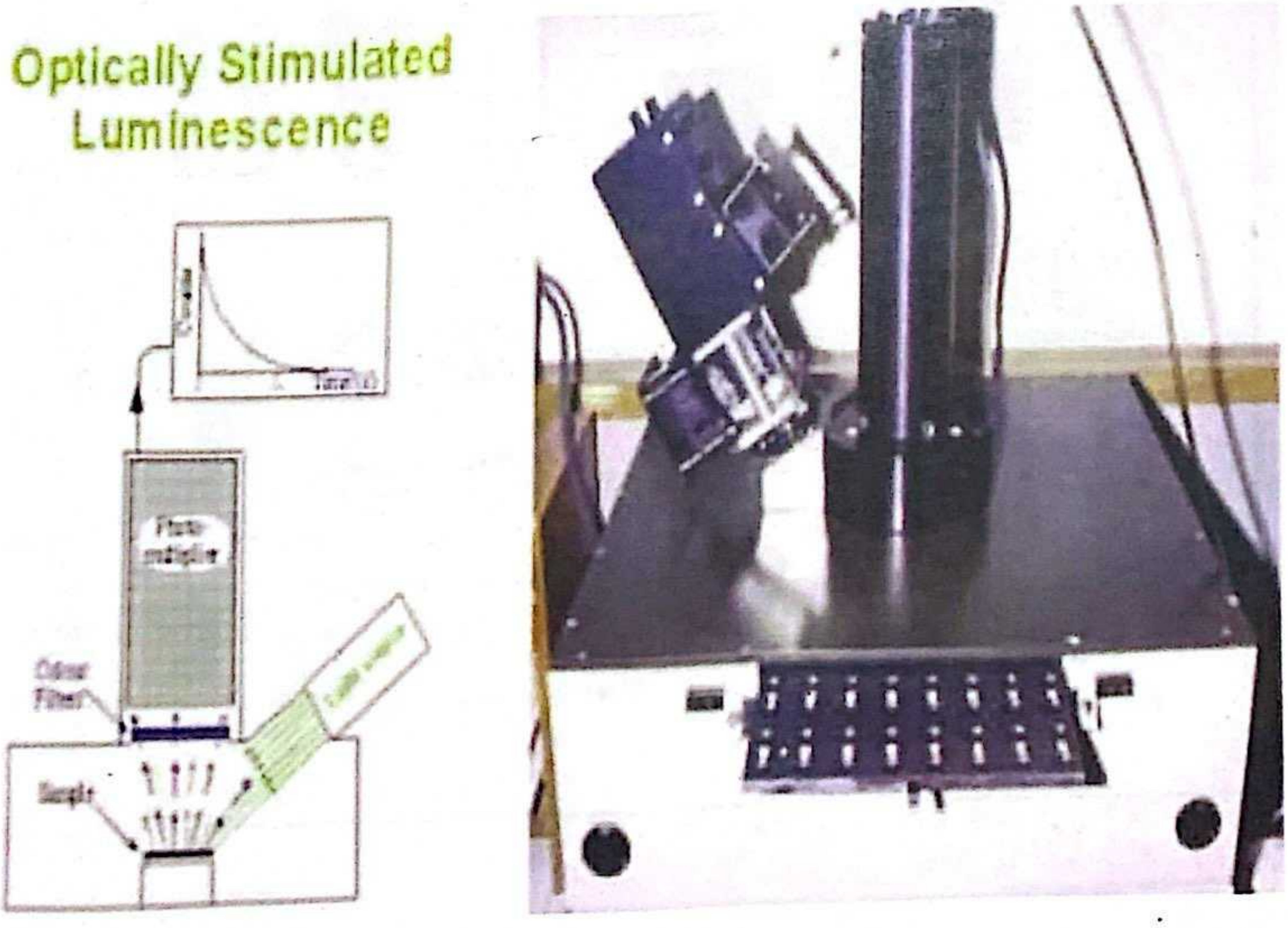
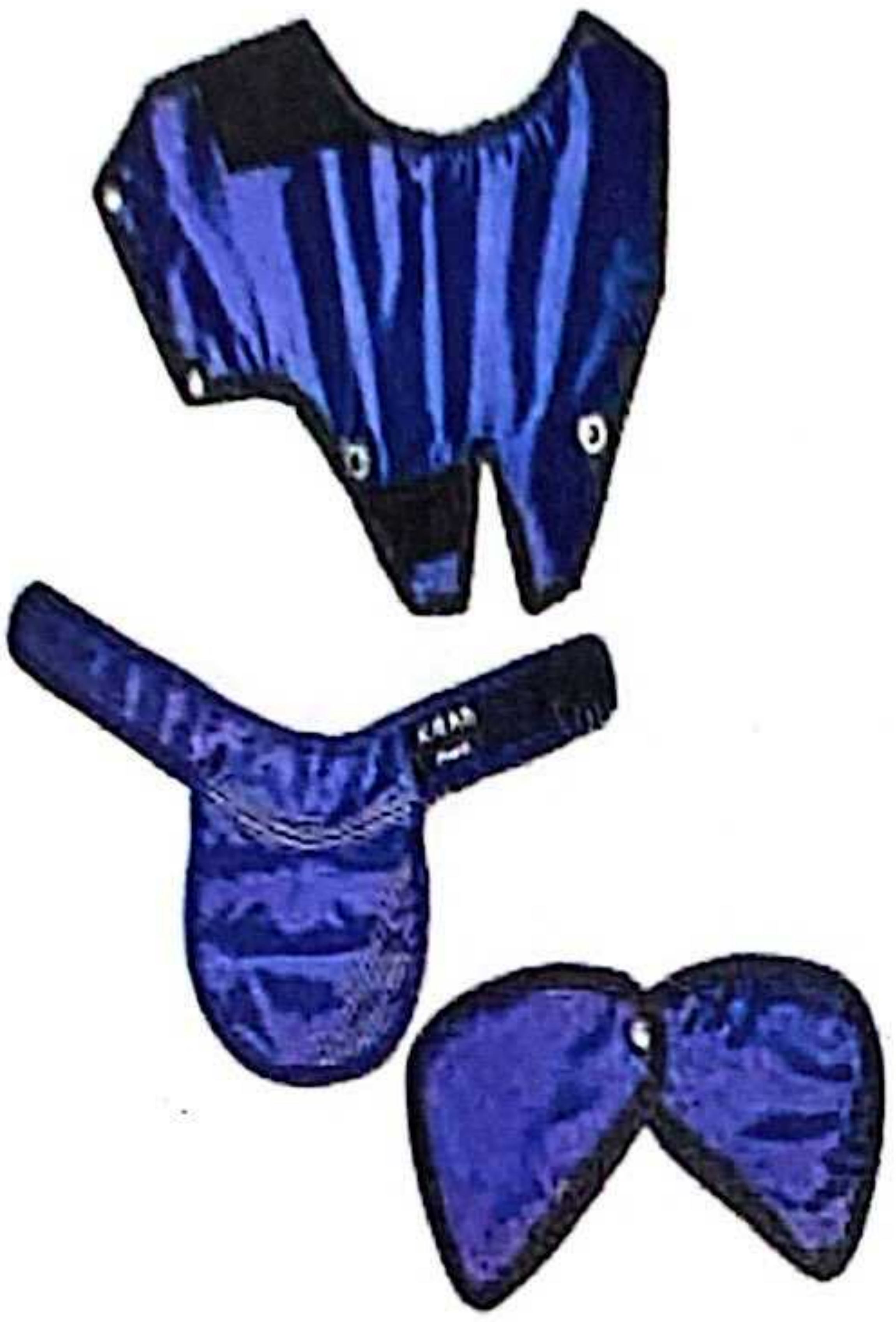
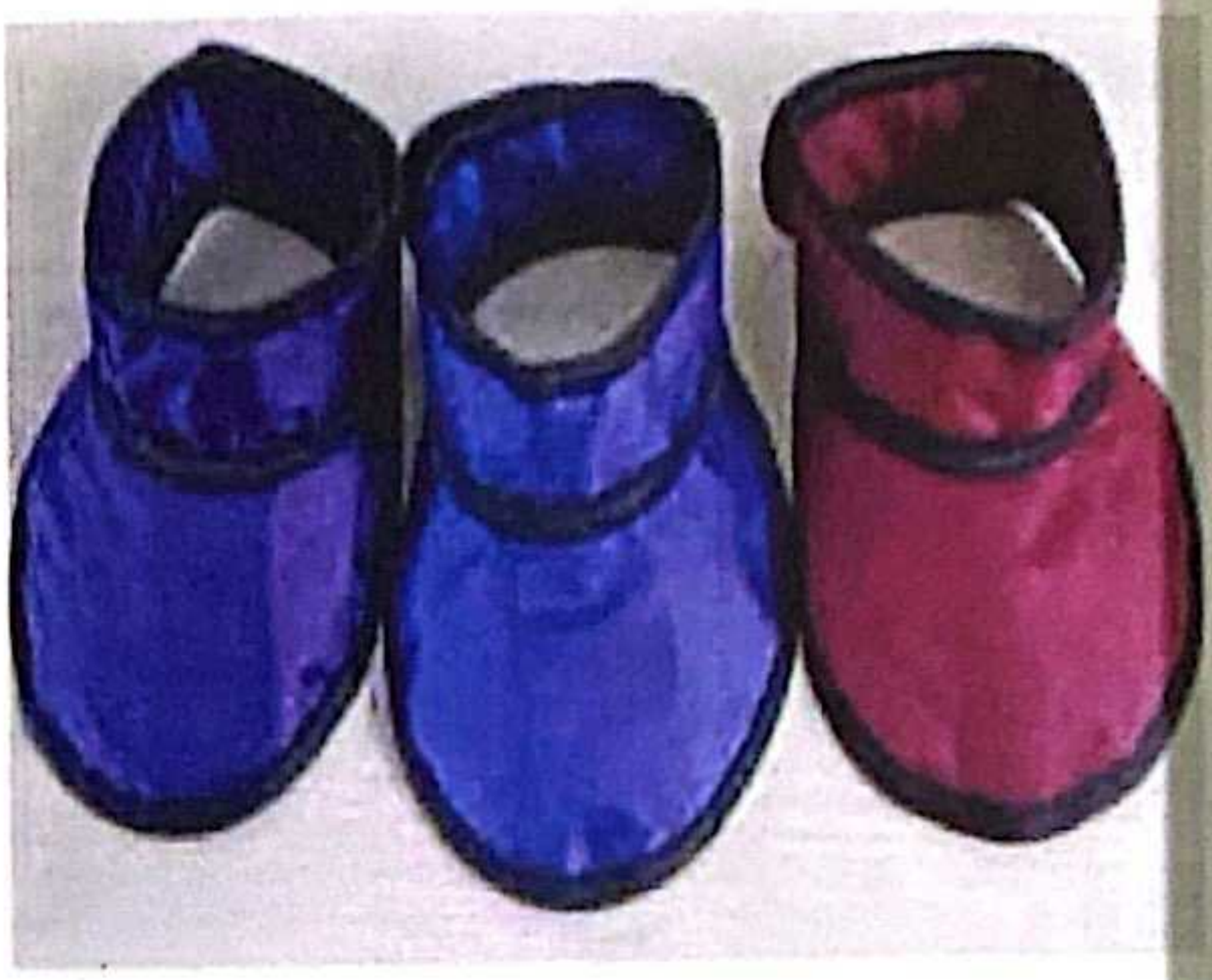


Photo multiplier
Colour Filter
Sample
Light source
Time (s)

Q.5) **(2015)**





FA11 Lead Rubber Collar(0.35mmpb lead equivalent)

Apparel	Thickness (mm)	Attenuation (%)
Apron	0.50	99.9
Gloves	0.25	99
Thyroid	0.50	99
Glasses / Collar	0.35	99
Fluoroscopic drape	0.25	99

Three Principles of radiation protection are:

1. Justification
2. Optimization
3. Dose Limit

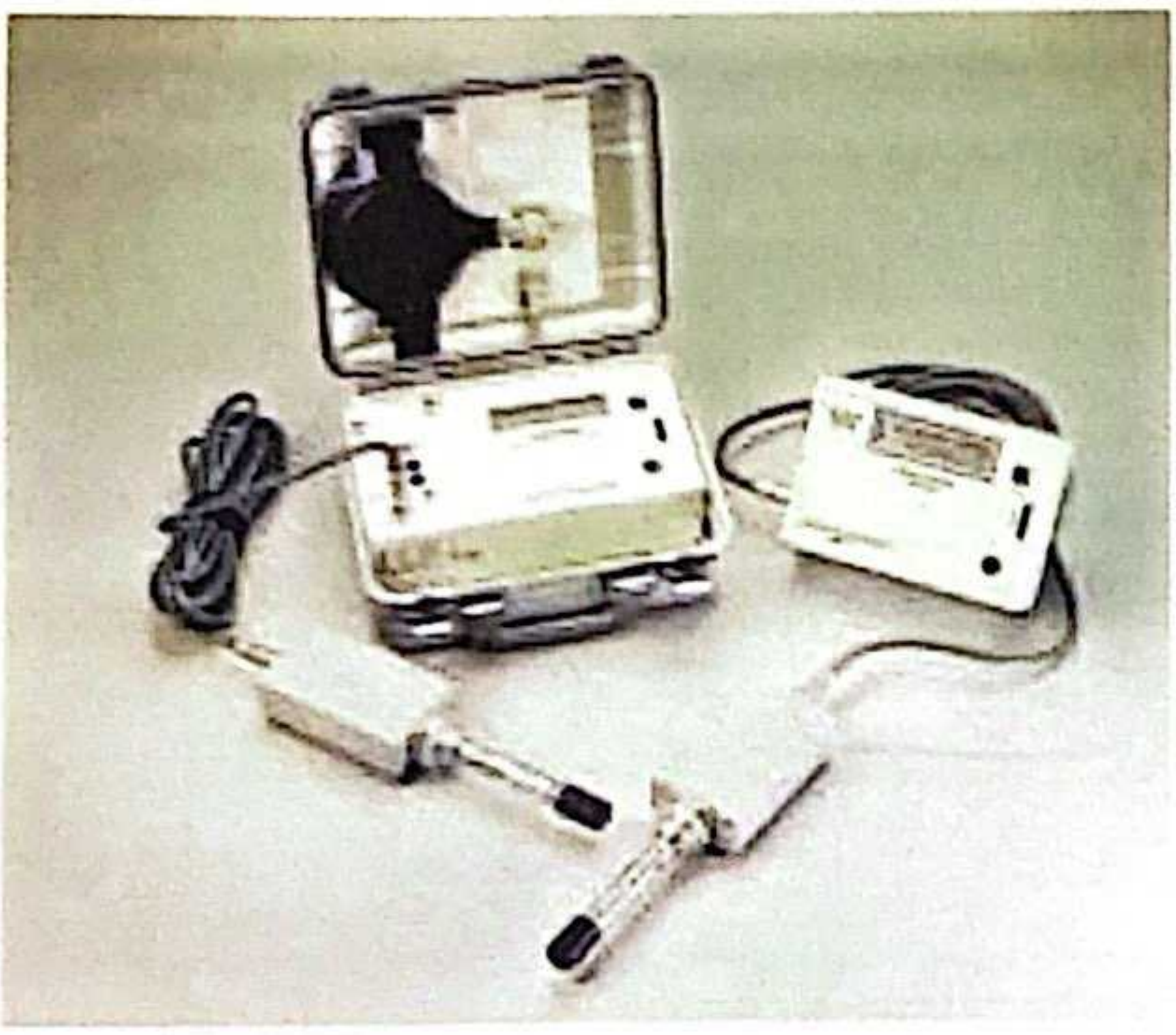
Other Methods:

1. Increase distance
2. ALARA

TABLE 21.3 EFFECTIVE DOSE LIMIT RECOMMENDATIONS

	Dose Limit Values
Occupational Exposures	
Effective dose limits	
a. Annual	50 mSv (5 rem)
b. Cumulative	10 mSv × age (1 rem × age)
Equivalent annual dose limits for tissues and organs	
a. Lens of eye	150 mSv (15 rem)
b. Skin, hands, and feet	500 mSv (50 rem)
Public Exposure (Annual)	
Effective dose limit	
a. continuous or frequent exposure	1 mSv (0.1 rem)
b. infrequent exposure	5 mSv (0.5 rem)
Equivalent dose limits for tissues and organs	
a. Lens of eye	15 mSv (1.5 rem)
b. Skin, hands, and feet	50 mSv (5 rem)
Embryo/Fetus Exposures	
a. Total equivalent dose limit	5 mSv (0.5 rem)
b. Monthly equivalent dose limit	0.05 mSv (0.05 rem)
Education and Training Exposures (Annual)	
Effective dose limit	1 mSv (0.1 rem)
Equivalent dose limits for tissues and organs	
a. Lens of eye	15 mSv (1.5 rem)
b. Skin, hands, and feet	50 mSv (5 rem)

Q.6) **(2015)**



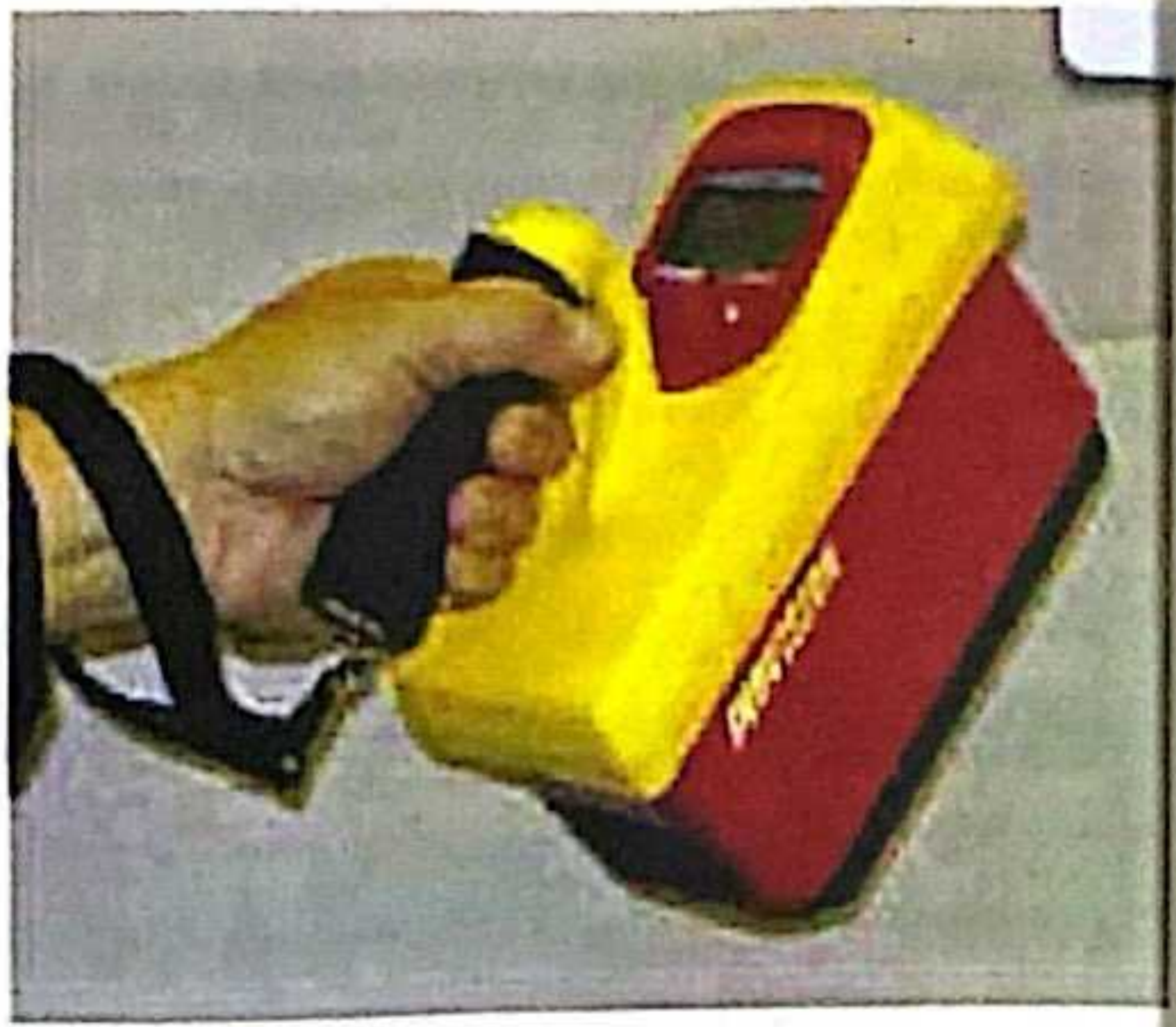
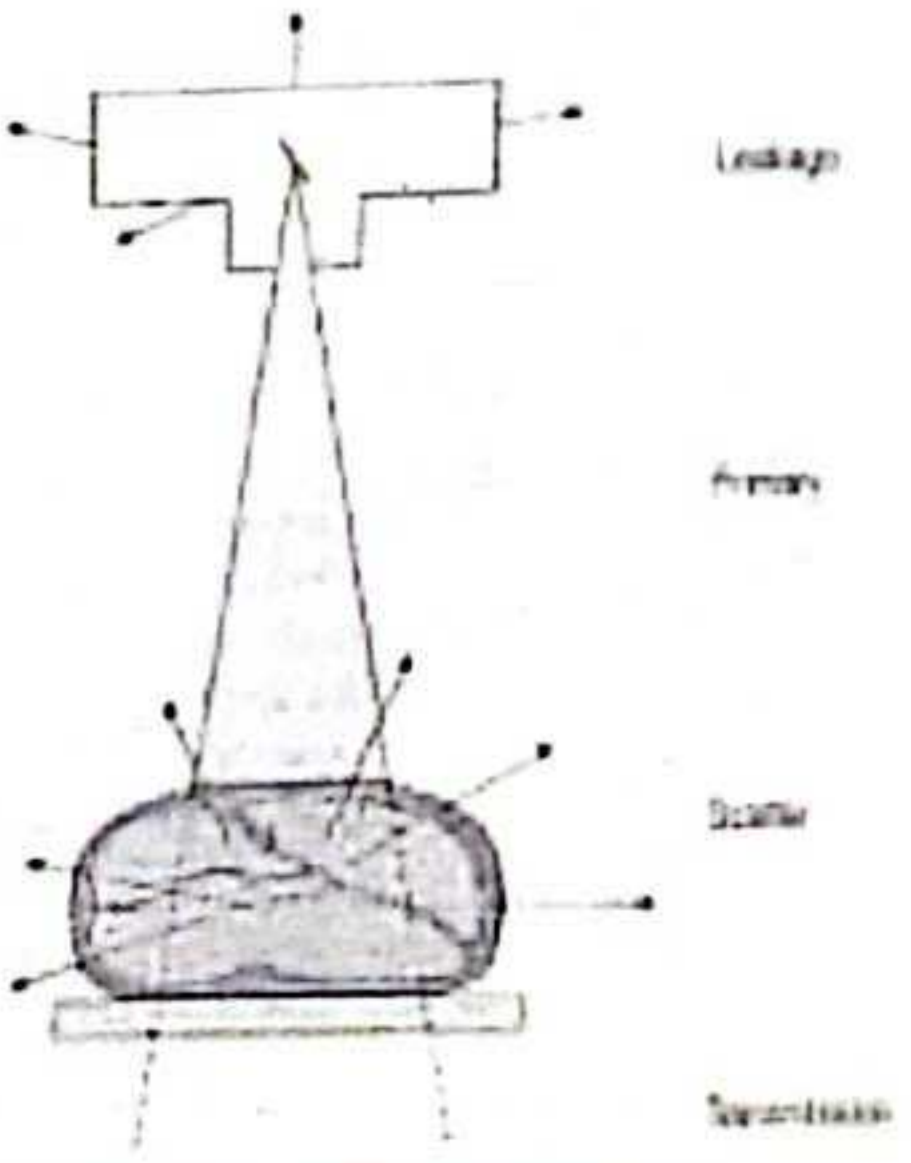


FIGURE 16-8 This portable ion chamber survey instrument is useful for radiation surveys when exposure levels are in excess of 10 μGy$_a$/hr. (Courtesy Cardinal Health, Inc.)

On chamber Dosimeter

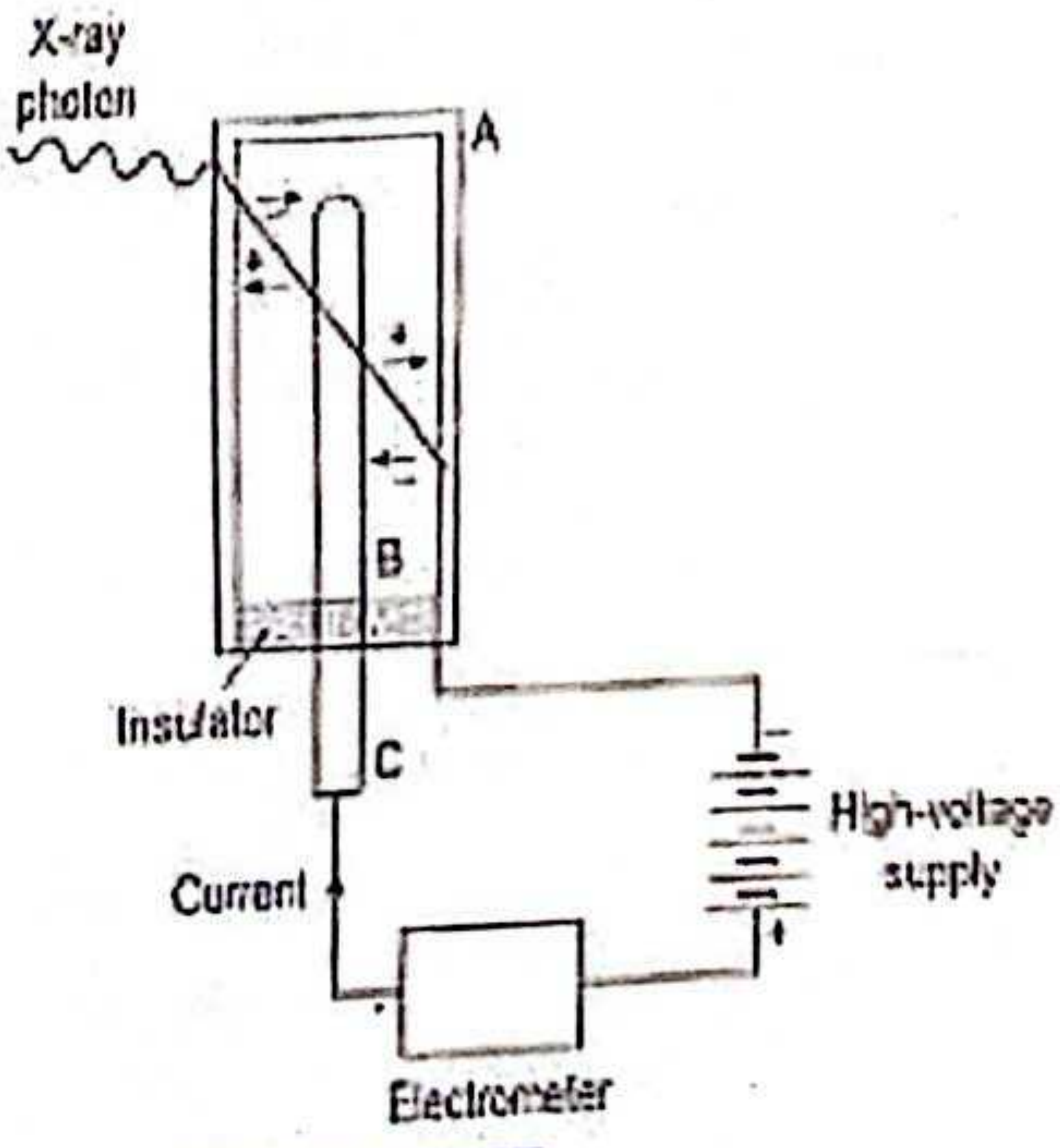
Dose area product meters:



Leakage
Primary
Scatter
Transmission

Figure 2.5 Radiation sources in the X-ray room

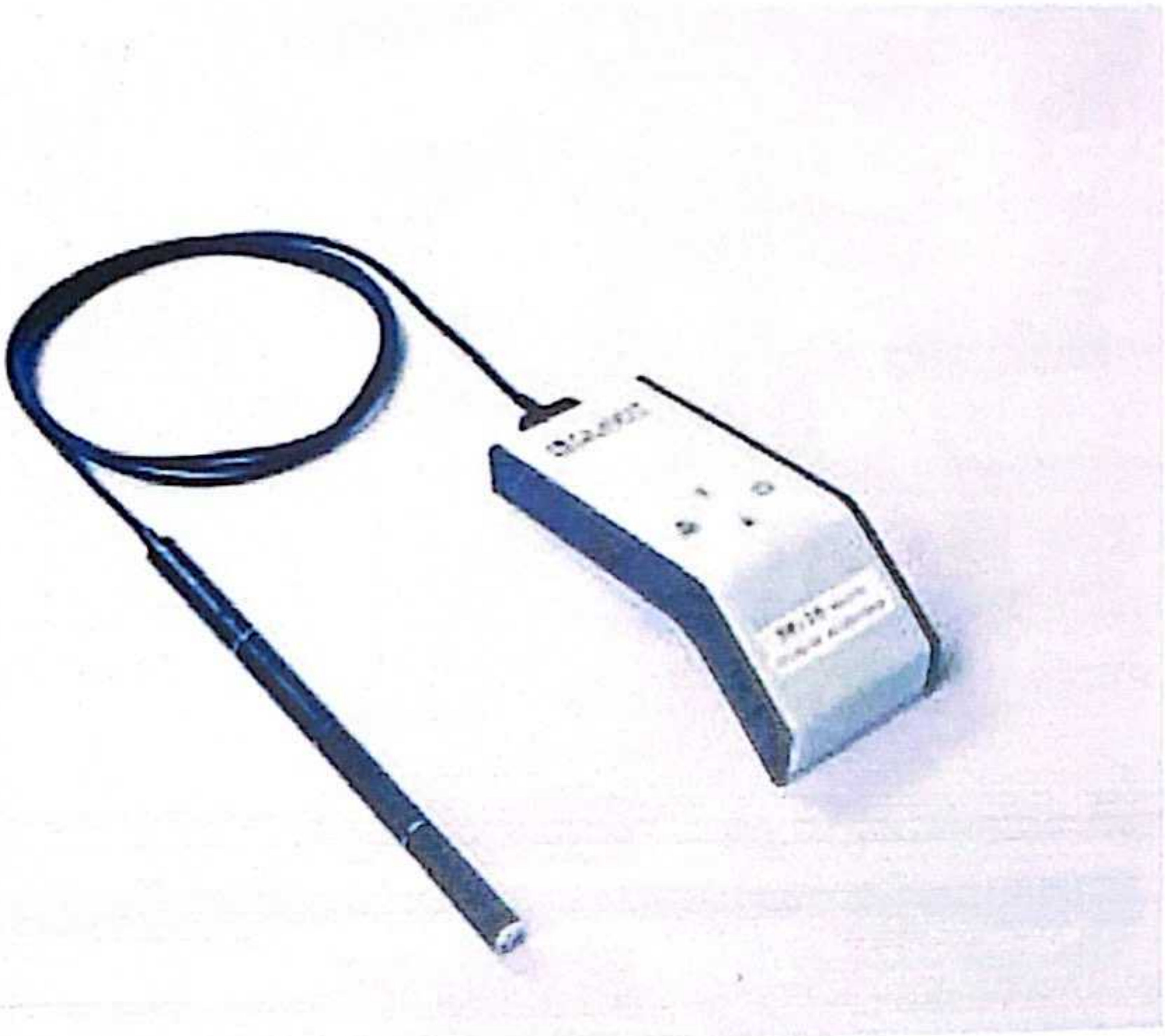
- Dose area product meters are used for the assessment of patient dose (DAP) and volume of tissue irradiated. They use an ionization chamber mounted on the collimator of the X-ray tube. The chamber is a parallel plate type, generally with square plates. It has an area bigger than the maximum beam size at the position at which it is mounted sealed chamber so as to avoid changes in calibration caused by changes in temperature and pressure.
- DAP for patient dose audits
- DAP increases with increasing field size.
- Small field size lower DAP so less risk as smaller amount of tissue exposed.
- cGy-cm2



X-ray photon
A
B
C
Insulator
Current
High-voltage supply
Electrometer

Figure 1.20 Ionization chamber.

Q.7) Pencil Ionization Chamber



Dose Audit:

- Comparing air kerma
- Air kerma is determined by amount of ionization produced by photon beam in air.
- **Dose area product meters are used for dose audit**

Air kerma rate:

- Approximately proportional to the square of the kV
- Proportional to the mA
- Inversely proportional to the square of the distance F from a point source.

Kerma is an acronym for kinetic energy released to matter.

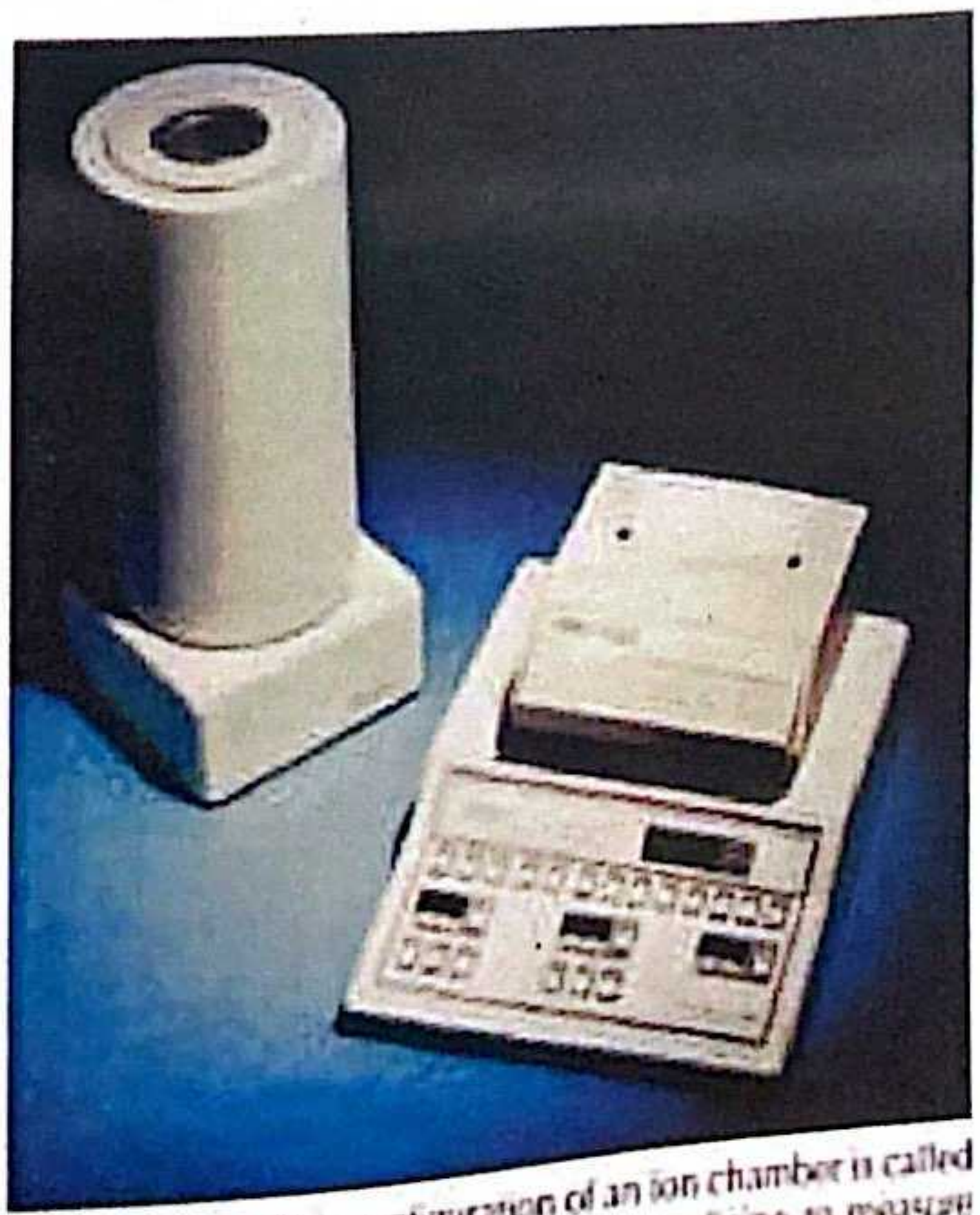


FIGURE 16-10 This configuration of an ion chamber is called a dose calibrator. It is used in nuclear medicine to measure of radioactive material. (Courtesy Biodex

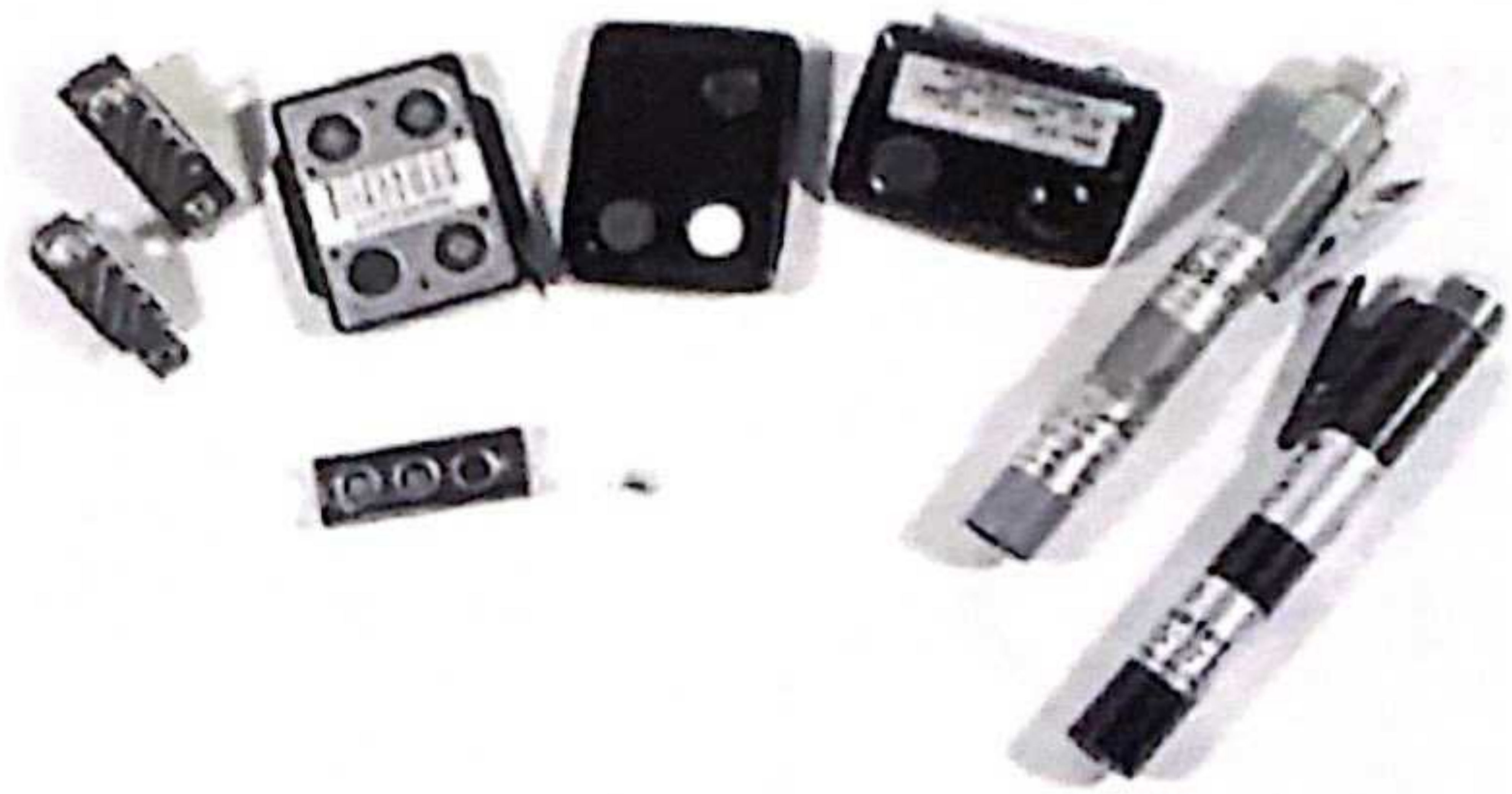
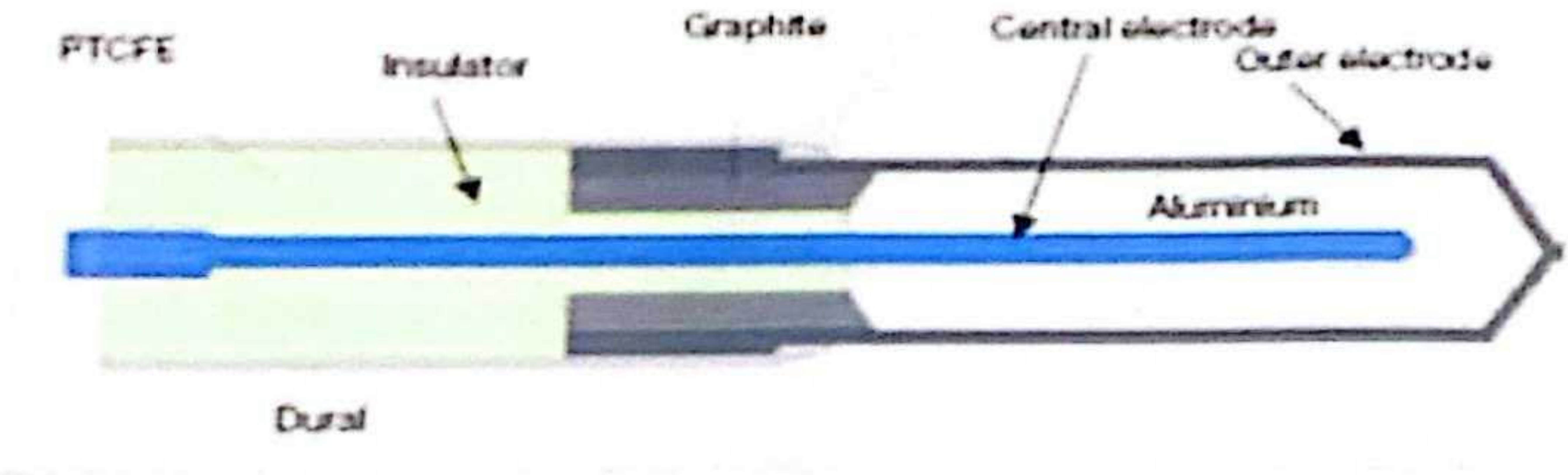
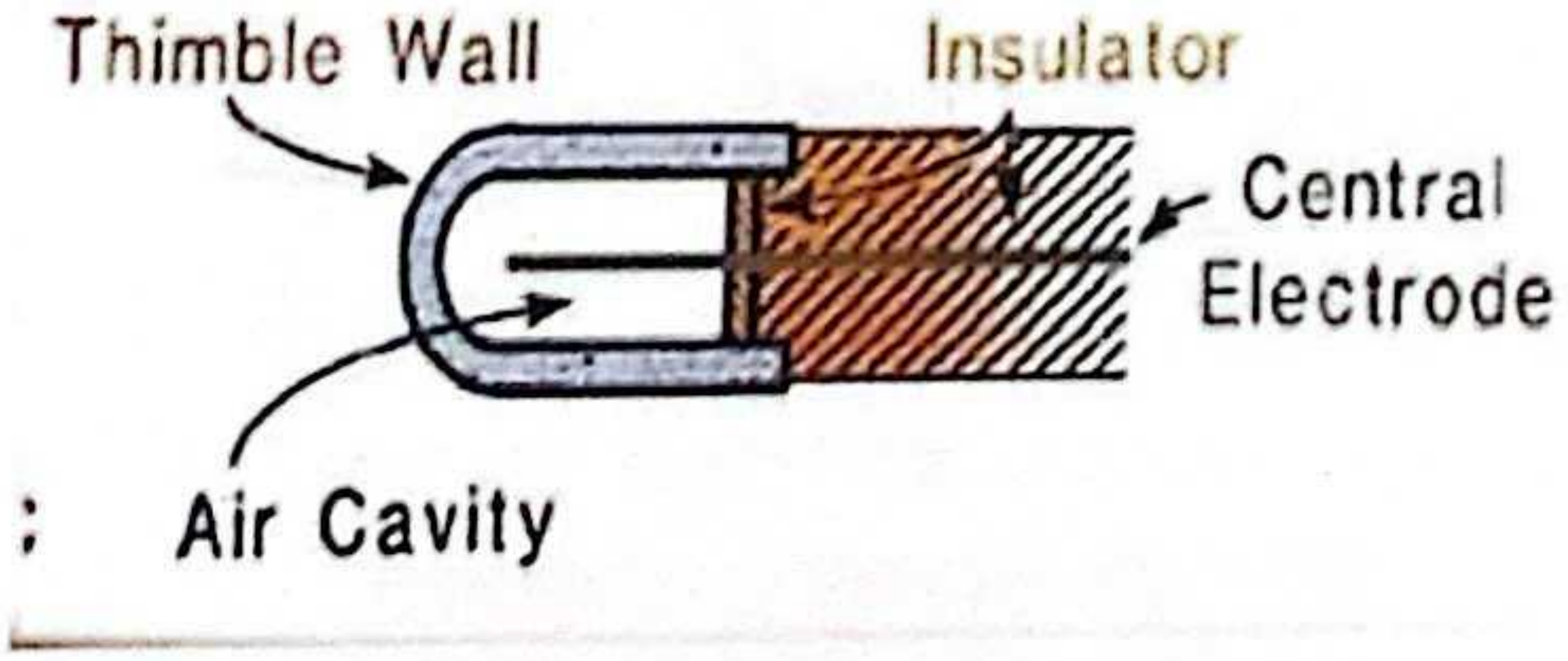


Figure 20.7. A variety of personnel monitors.


PTCFE
Insulator
Graphite
Central electrode
Outer electrode
Aluminium
Dural

Thimble/Farmer Chamber


Thimble Wall
Insulator
Central Electrode
Air Cavity

Thimble Chamber

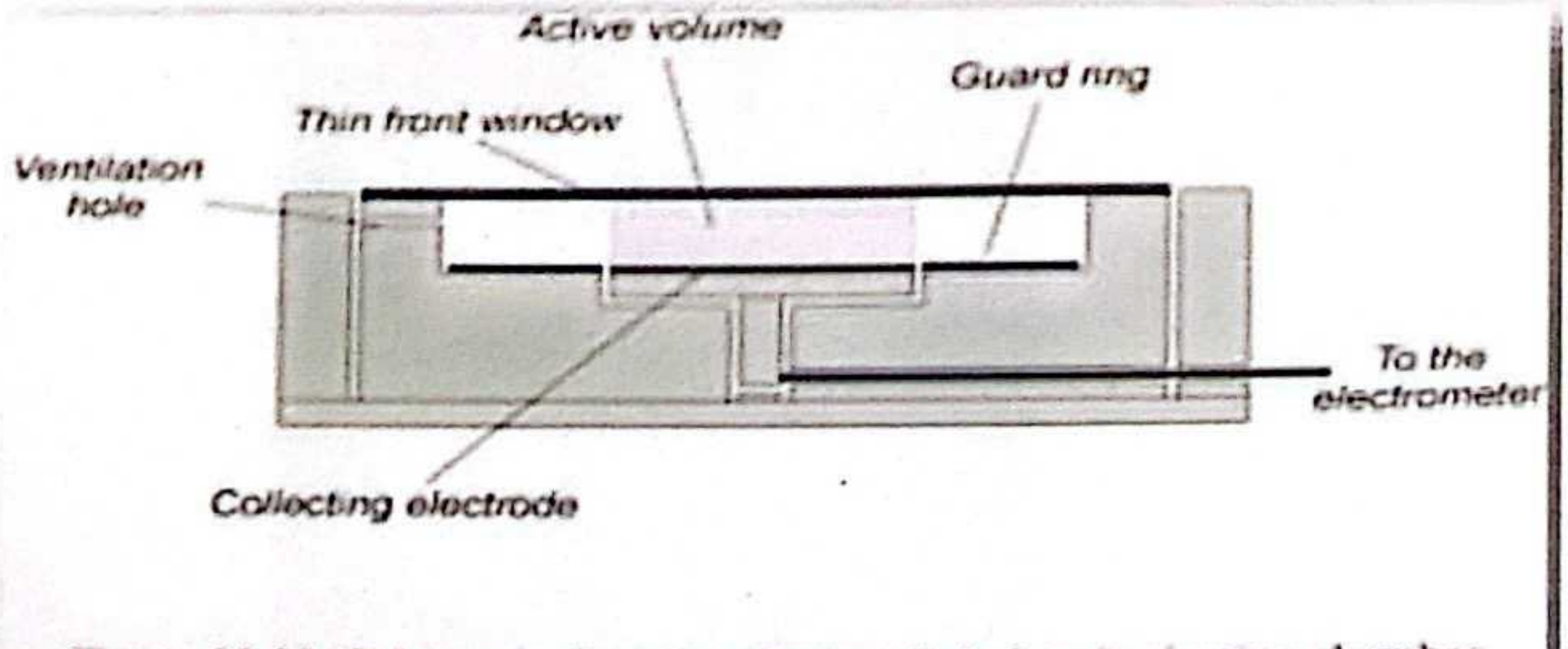

Active volume
Guard ring
Thin front window
Ventilation hole
To the electrometer
Collecting electrode

Figure 18.14: Schematic drawing of a parallel plate ionization chamber

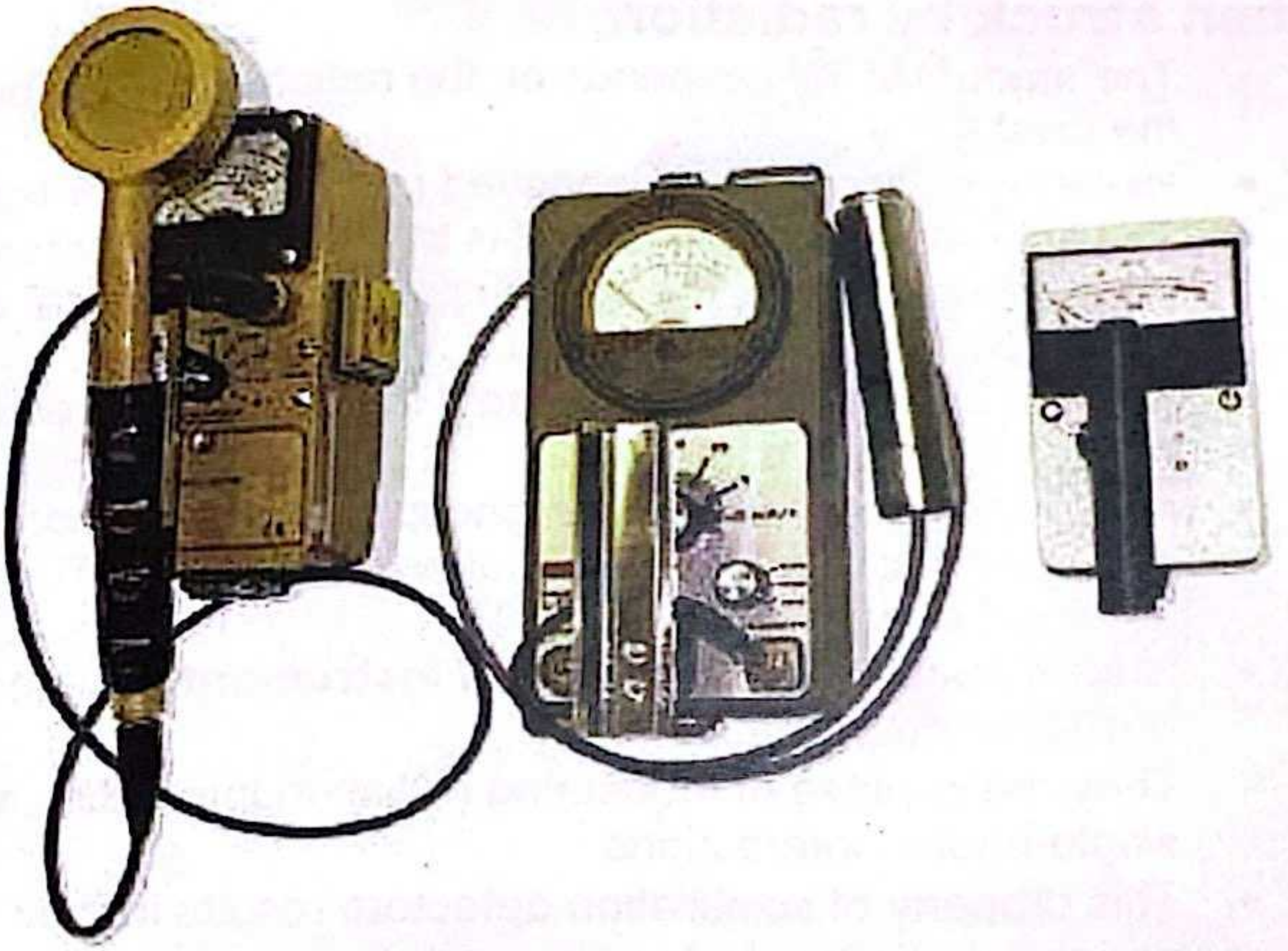


Figure 20.6. Portable Geiger-Muller counters and ion chambers used for radiation surveys.

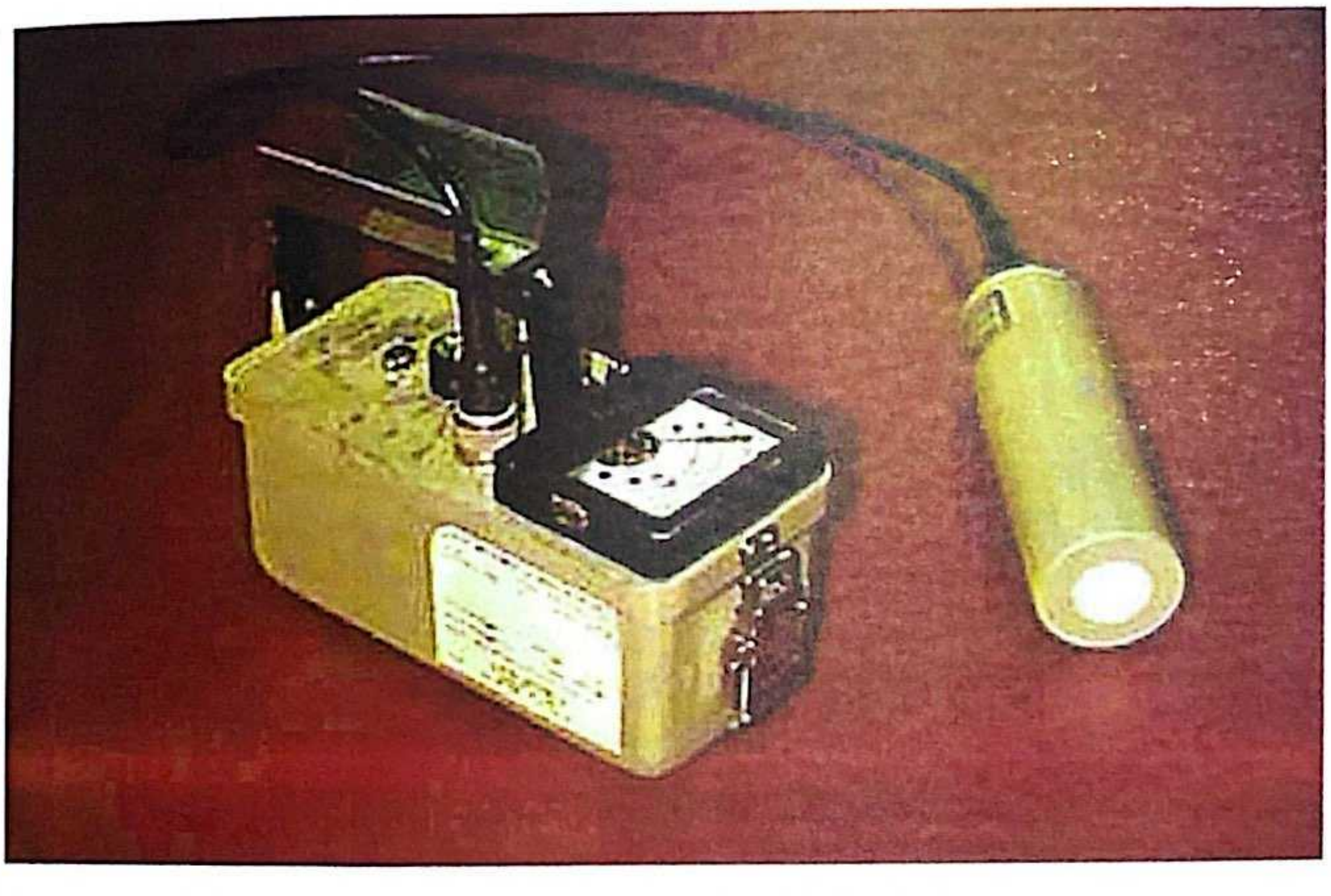
Scintillation detectors use crystals that give off light when struck by radiation.

- The amount of light depends on the radiation energy deposited in the crystal.
- Higher radiation energy deposited results in greater light emission.
- The light emitted by the crystal is detected by a photomultiplier tube, which converts the light output into an electrical output signal, which is then measured.
- Scintillators are used as detectors in CT scanners and nuclear medicine gamma cameras
- Most widely used scintillation phosphors are the inorganic crystals—thallium-activated sodium iodide (NaI : TI) and thallium-activated cesium iodide (CsI : TI).
- **High sensitivity means that an instrument can detect very low radiation intensities.**
- They are capable of measuring radiation intensities as low as single-photon interactions.
- This property of scintillation detectors results in their use as portable radiation devices in much the same manner as Geiger counters are used.
- A portable scintillation detector is more sensitive than a Geiger counter because it has much higher detection efficiency.
- **For this application, the scintillation detector would be used to monitor the presence of contamination and perhaps low levels of radiation.**

Scinti-RAD
Gammasonics

LABR-1.5x1.5 - LaBr3(Ce)
Scintillation Detector

97.0



GRAPHS

Q.1) **(2018)**

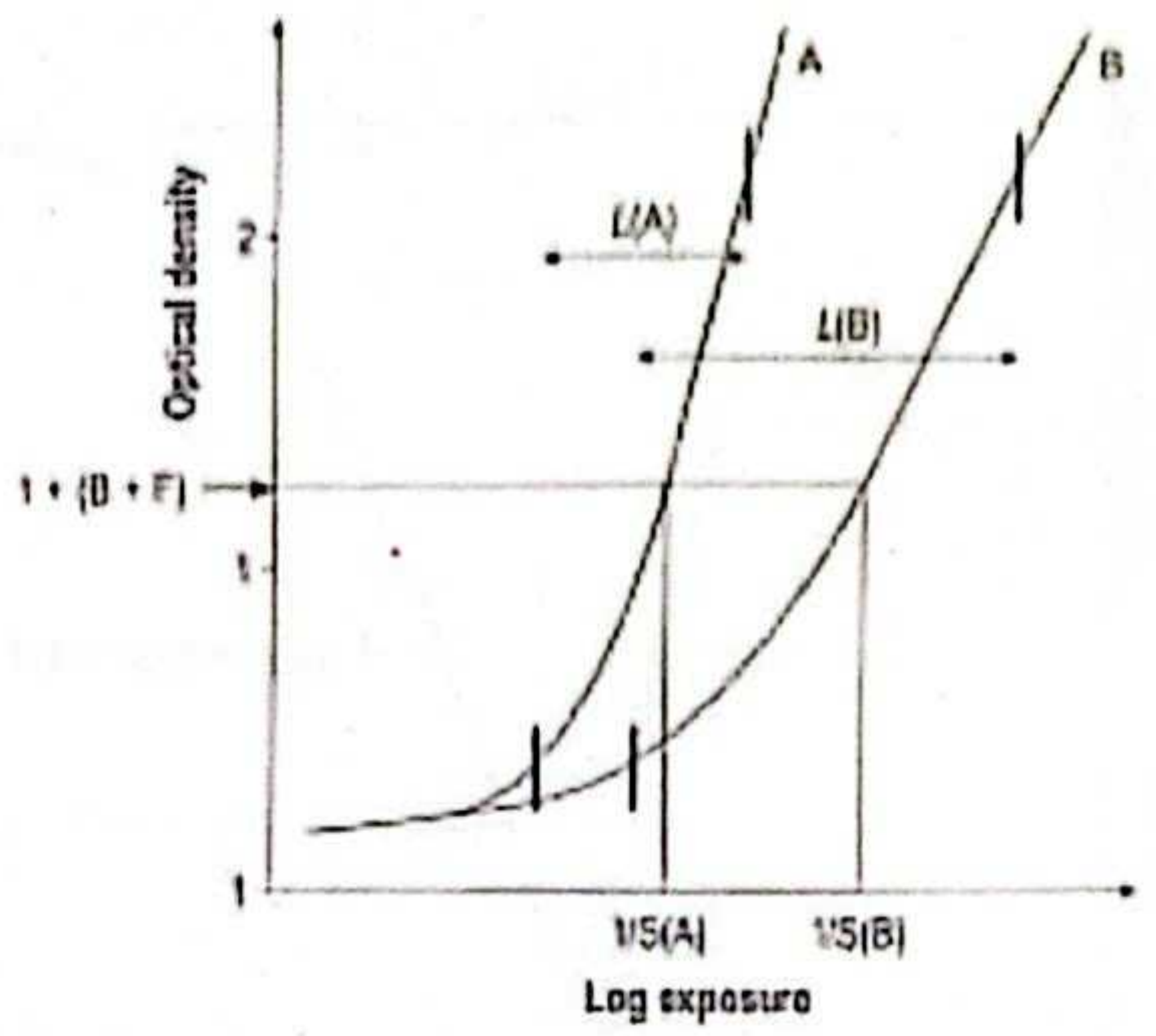


Figure 4.3 Characteristic curves for two film-screen combinations

Identify: Characteristic curves for two film-screen combinations.

Which curve has highest:

Speed: B

Latitude: B

Gamma: A

Density: A

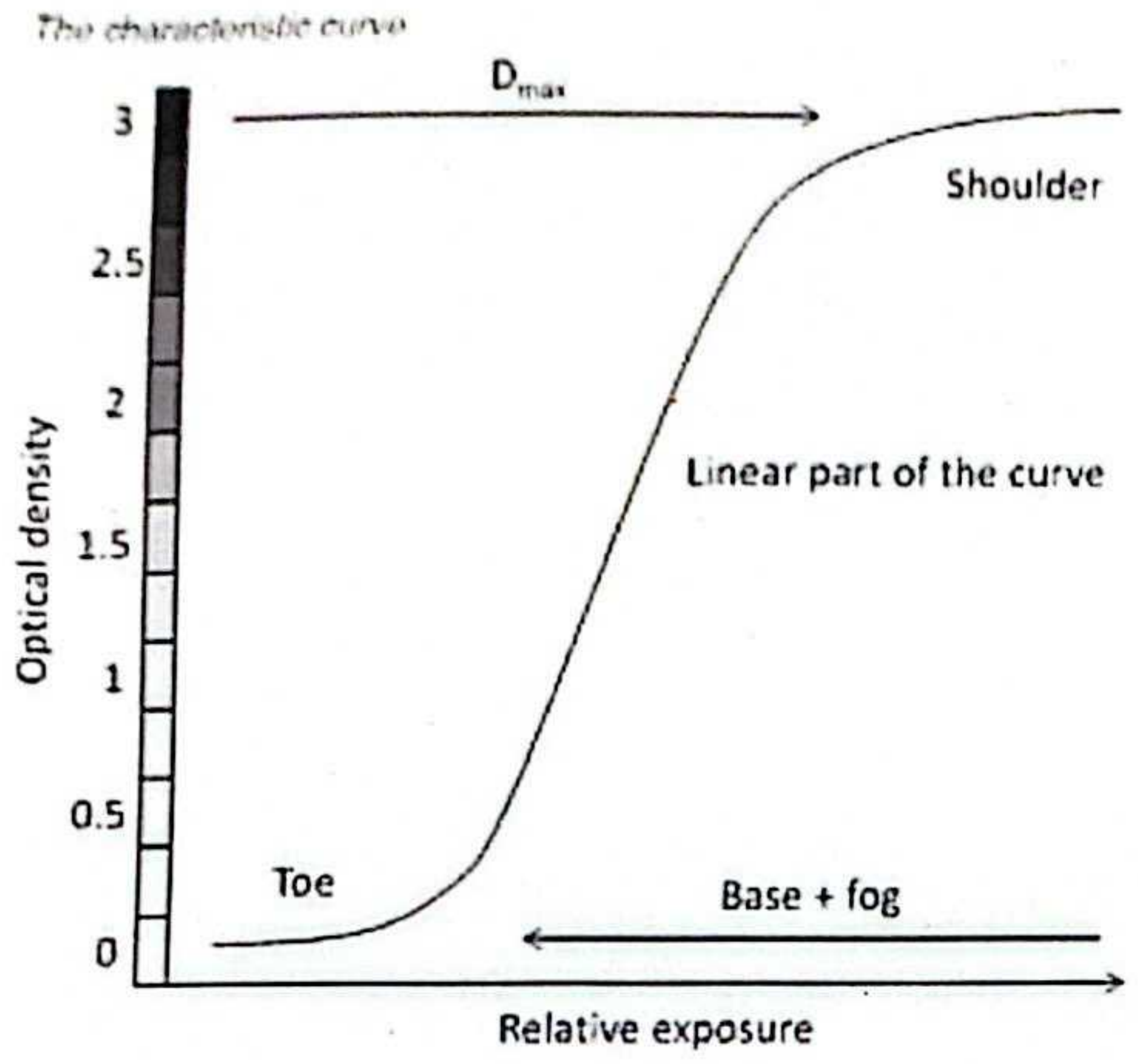
Base plus fog level (B + F): is the density of processed but unexposed film. The film has an intrinsic base density due, about equally, to some of the silver bromide crystals having acquired latent images during manufacture and the film base absorbing light when viewed. Generally, the density of base plus fog is in the range 0.15-0.2.

Speed: is loosely defined here as the reciprocal of the exposure required to produce a net density of 1.0; that is, the density with the base plus fog subtracted. A net density of 1 is the approximate average density of a correctly exposed radiograph.

Film gamma: is the average slope of the characteristic curve, it influences the amount of contrast displayed in the radiographic image. Film A has a higher (a steeper slope), and it therefore displays more contrast than B because greater differences in density are produced for the same difference in exposure. The slope of the curve increases as exposure and density are increased, and generally refers to the average slope between net densities of 0.25 and 2.0. Typically, is in the range 2-3.

Film latitude: It is the range of exposures that produce net densities lying in the useful density range between 0.25, below which the gradient is too low, and 2.0, above which the film is too dark for details to be seen using a normal illuminator. For 2.5, the log of the difference in the doses to give net densities of 0.25 and 2.0 is equal to 1.75/2.5 = 0.7. This represents a dose ratio of 5.

Q.2) (2017), (2015)



Name: Charecteristic curve
Useful Optical density Range: 0.25 to 2.5
Effect of film gamma on radiographic image?

- Film Gamma is directly propotional to contrast
- Increase gamma ll increase contrast

The behaviour of the film when exposed to light is represented by its characteristic curve.

Low exposure (Toe): small increases in exposure produces hardly any change in density resulting in a white image with no contrast

Base plus fog: density produced on unexposed part of a developed film due to the density of the film itself and blackening caused by the emulsion. It is usually in the range of 0.15 to 0.2.

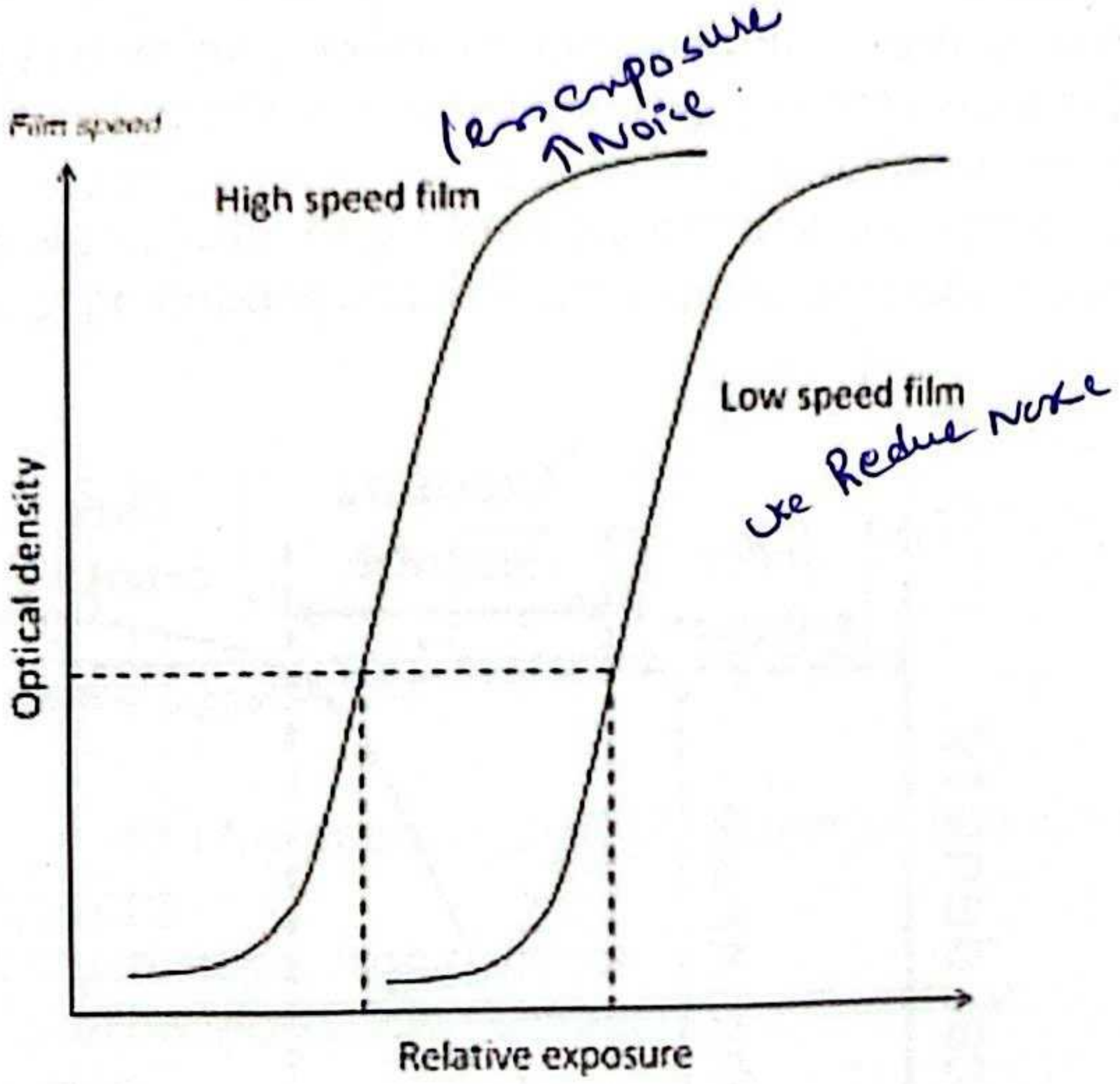
This increases if the film is stored for a long time or at too high a temperature.

Linear region: at high exposures the probability of producing a developable crystal increases with exposure. This is the region of most use and provides the highest contrast

High exposures (shoulder): at high exposures nearly all crystals will be developed resulting in a dark image with no contrast

Dmax: maximum density that a film can reach when all the grains are developed. Usually 3.5 to 4. Depends on the characteristics of the film and processing conditions.

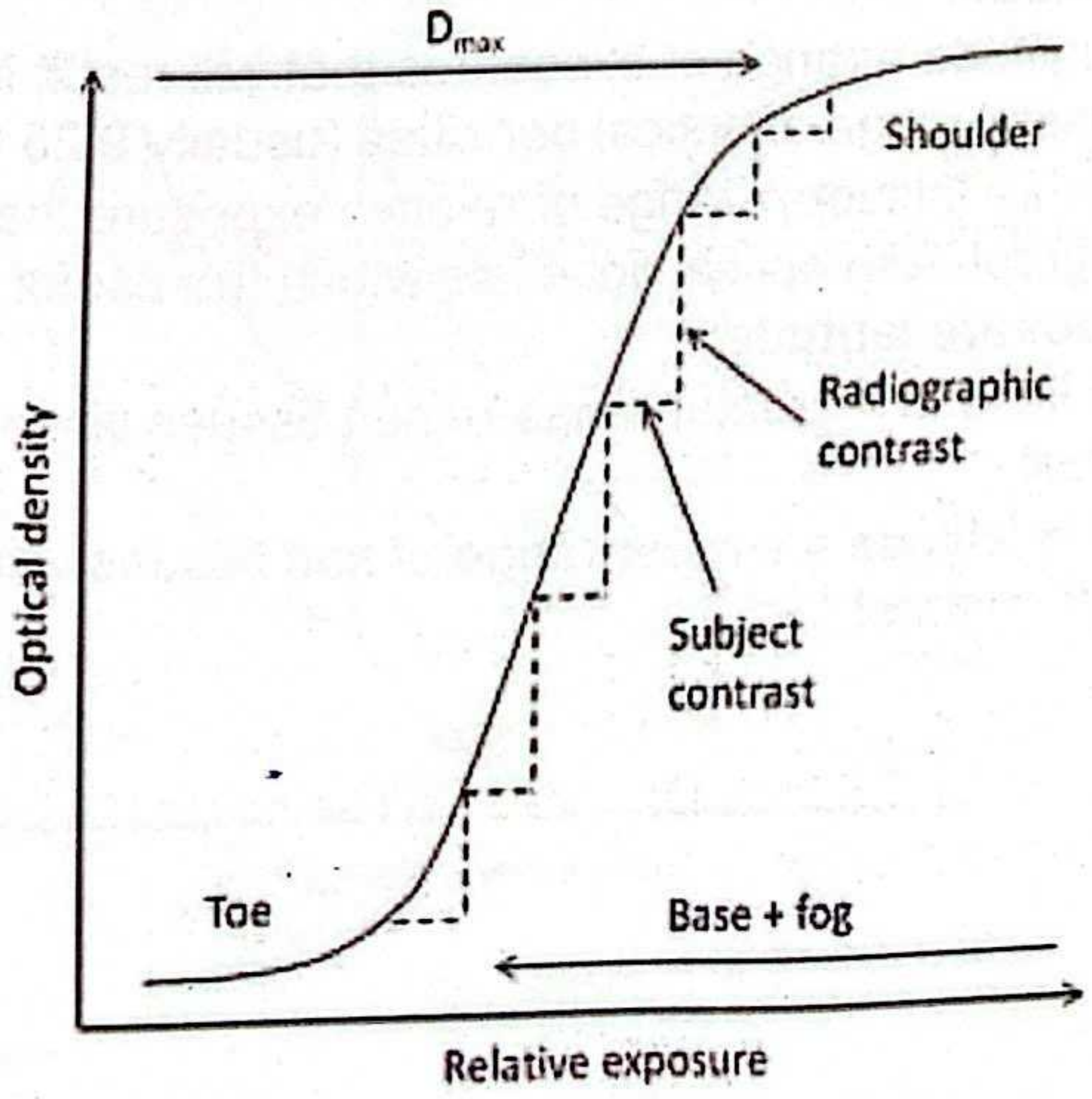
Film speed



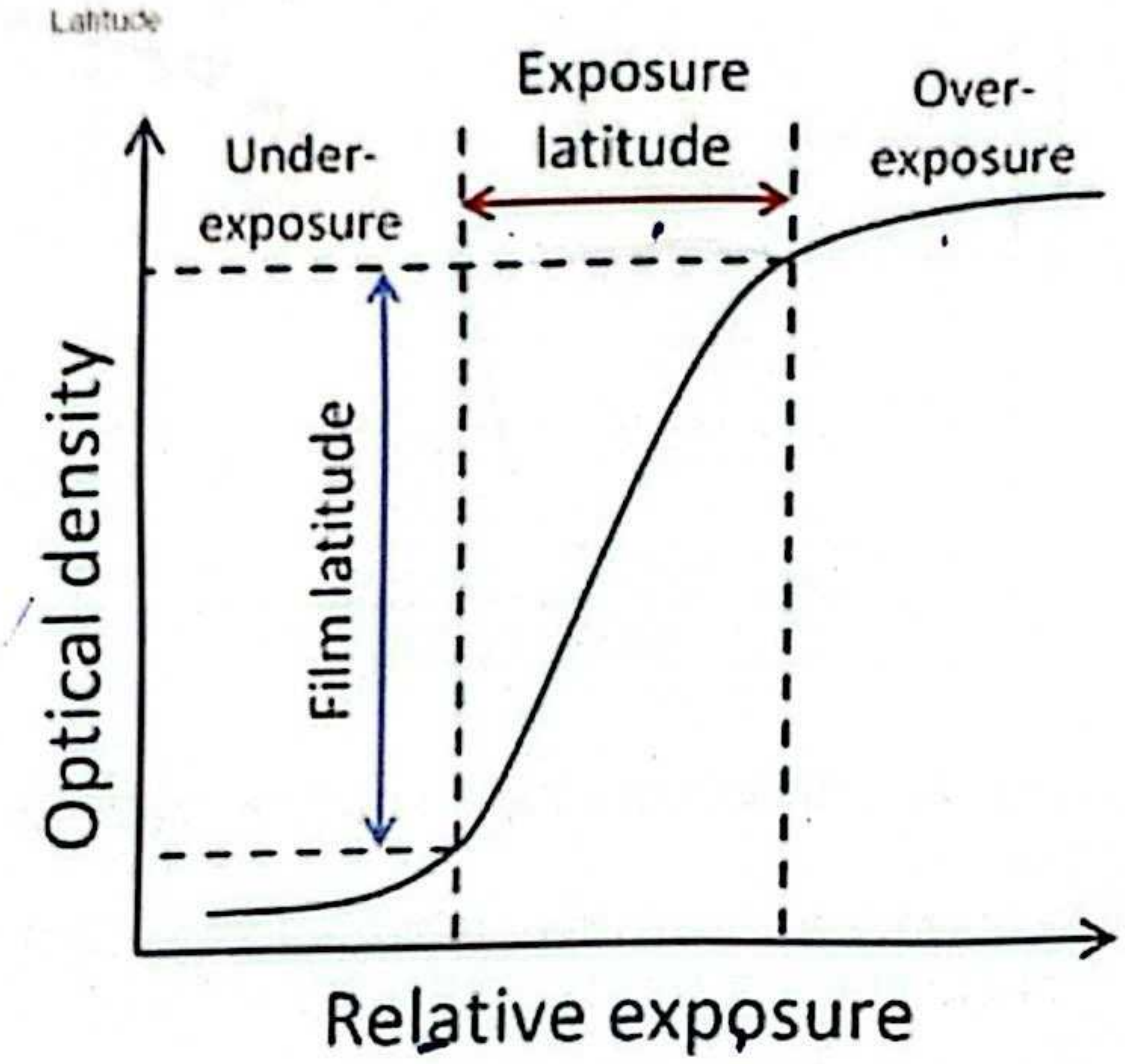
Aka the sensitivity. This determines the amount of exposure needed to produce an image.
The sensitivities of films are generally compared by the amount of exposure required to produce an optical density of 1 unit above the base plus fog density.
speed = 1000 / (air kerma required for density of base-plus-fog + 1)
The typical speed for a rare earth film screen combination is 400

- **High sensitivity:** requires less exposure but produces more noise
- **Low sensitivity:** used to reduce image noise

Contrast



Radiation contrast: aka subject contrast. The ratio of radiation intensities transmitted by different tissues or structures (a property of the object being imaged)
Radiographic contrast: the difference (not ratio) between optical densities produced in areas of the film corresponding to different tissue

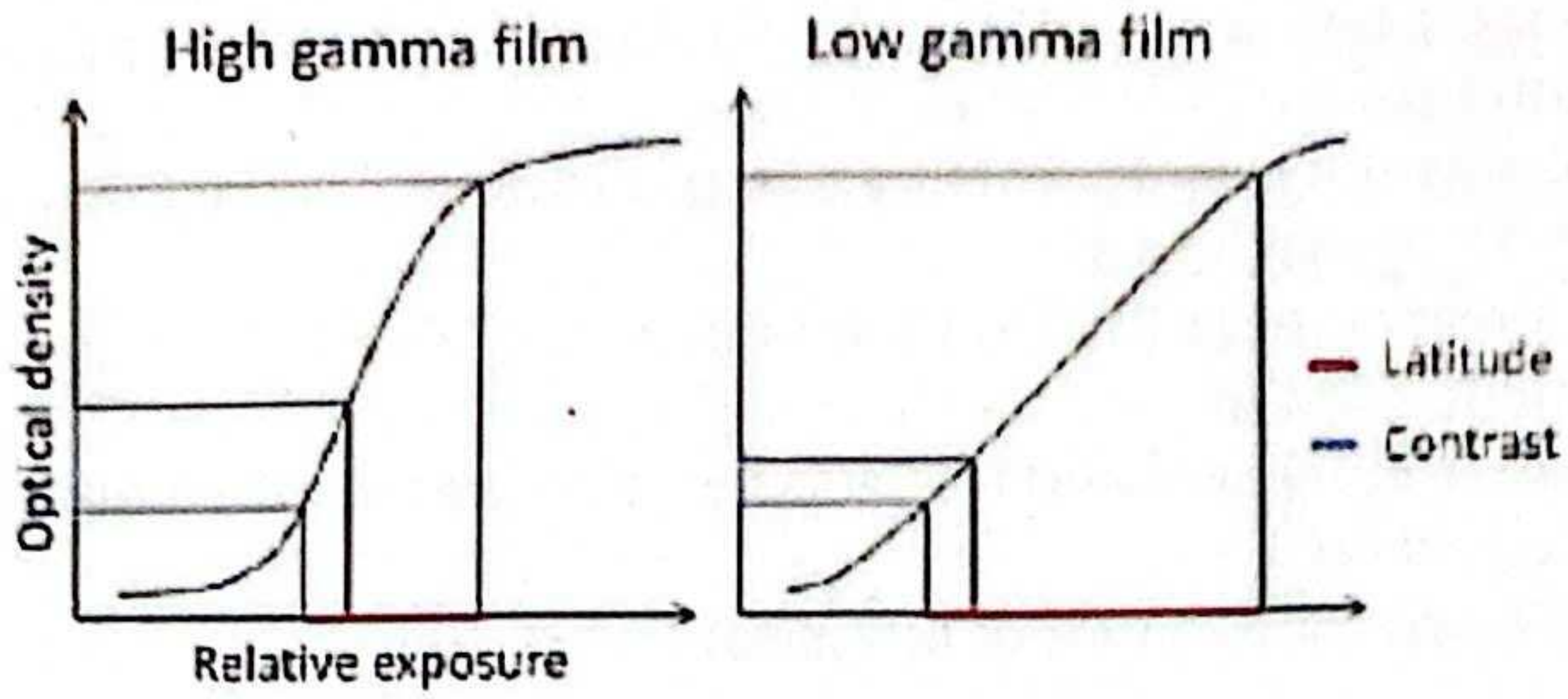


Types of latitude:

- Film latitude = range of exposures that will result in a density in the useful range of optical densities (usually 0.25 to 2)
- Exposure latitude = range of relative exposure that will produce a radiograph with optical densities within the useful range

Altering exposure latitude:

- Wide latitude = greater range of soft tissues visualised but poor contrast
- Narrow latitude = smaller range of soft tissues visualised but higher contrast

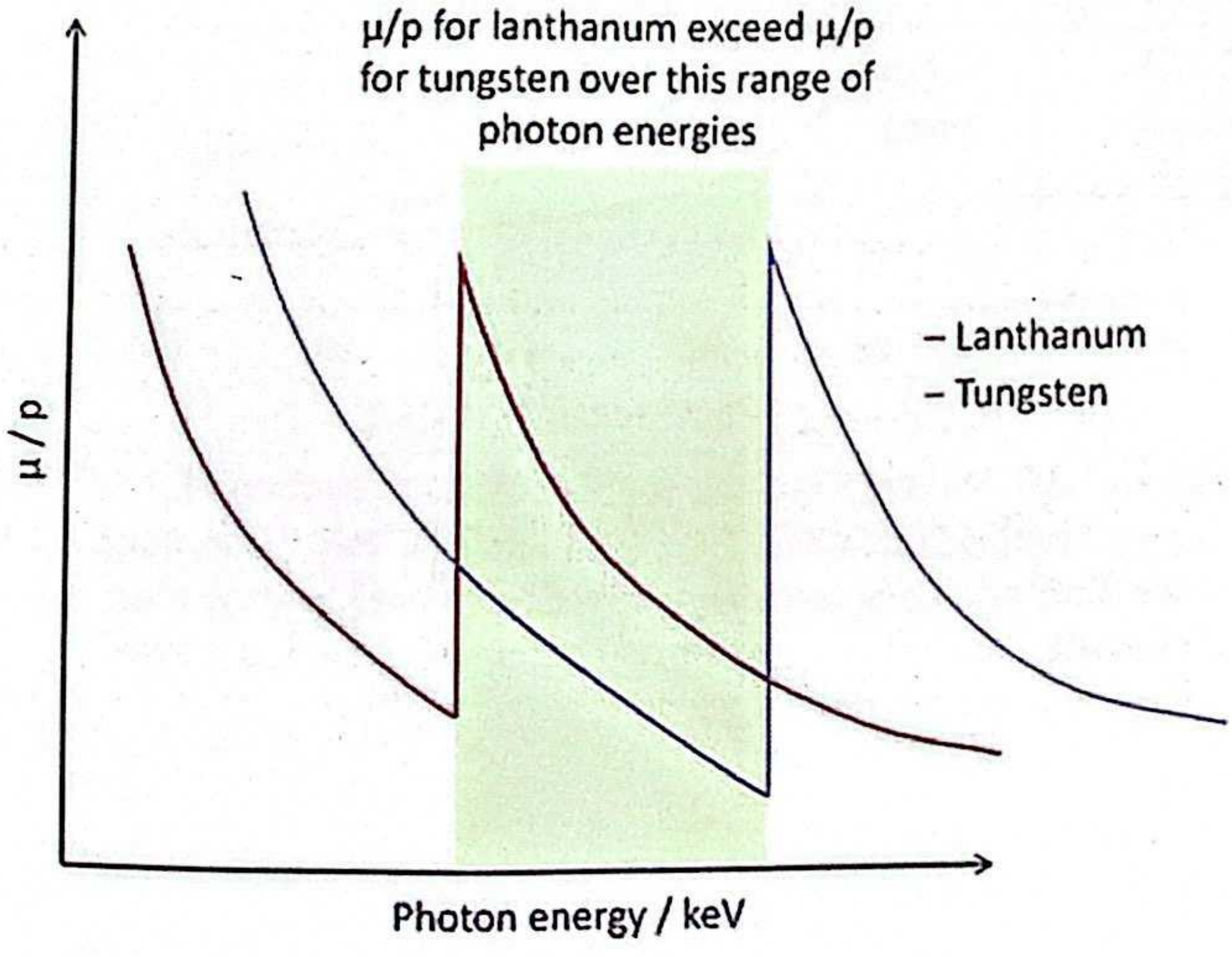


The gamma is the ratio between radiographic contrast and radiation contrast, i.e. the slope.

- High gamma: steep slope, high contrast
- Low gamma: shallow slope, low contrast

Effect of grain size

- **Large grain size:** fast emulsion. A larger grain presents a larger target for photons so fewer photons are needed to blacken film resulting in a faster film
- **Variable grain size:** small gamma. Grains of a uniform size tend to become developable at the same exposure. Therefore, that the range of exposures going from low to high density is small resulting in a large gamma.



Material

Calcium tungstate was widely used for its atomic number. More recentl "rare earth screens" have become the standard. They use gadolinium and lanthanum. Although Tungsten has a higher atomic number (Z=74) than lanthanum (Z=56) or gadolinium (Z=64) the K-edge of lanthanum is at 39 keV and this sudden increase in attenuation takes it mass attenuation coefficient (μ/ρ) above that of tungsten

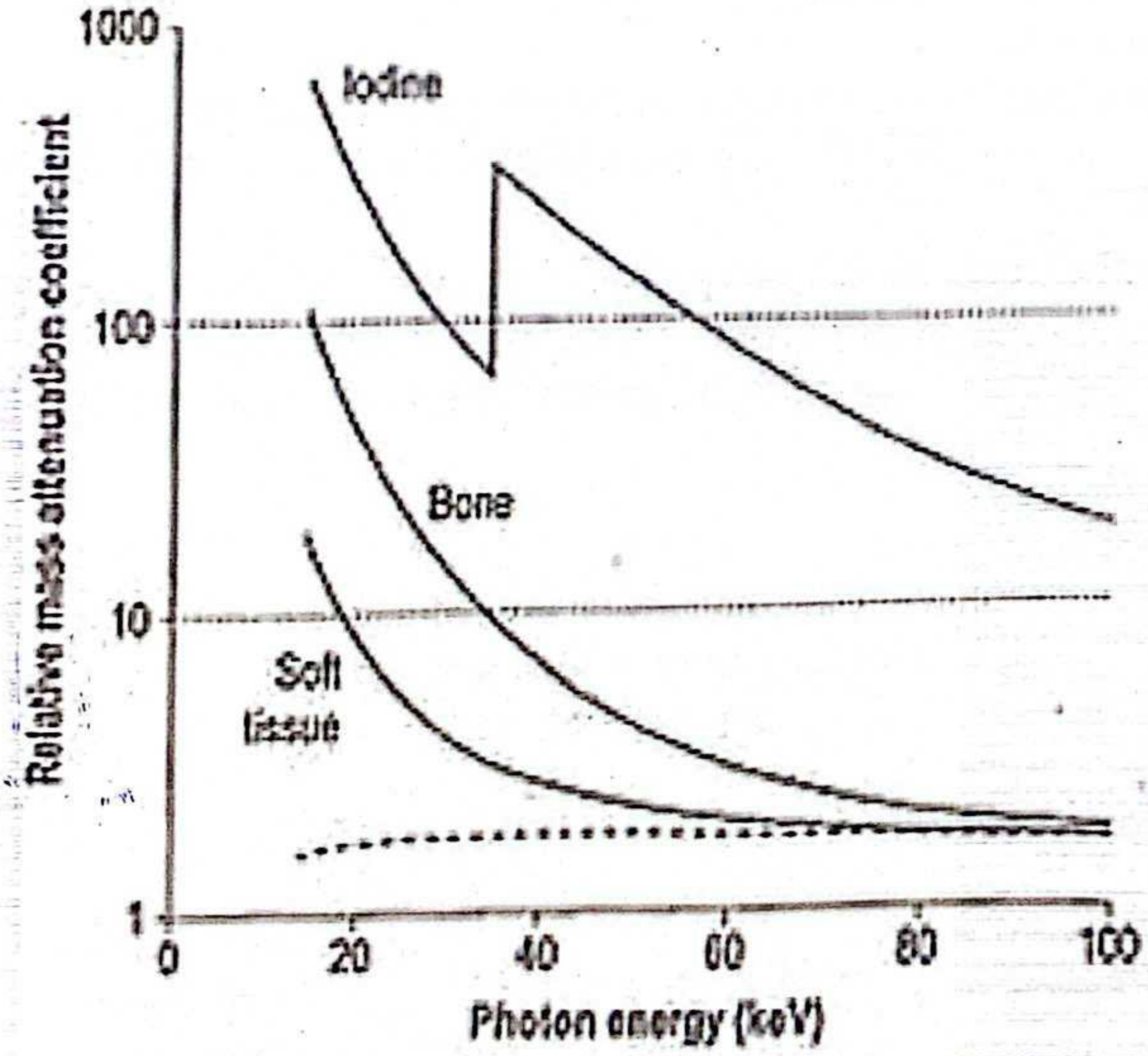
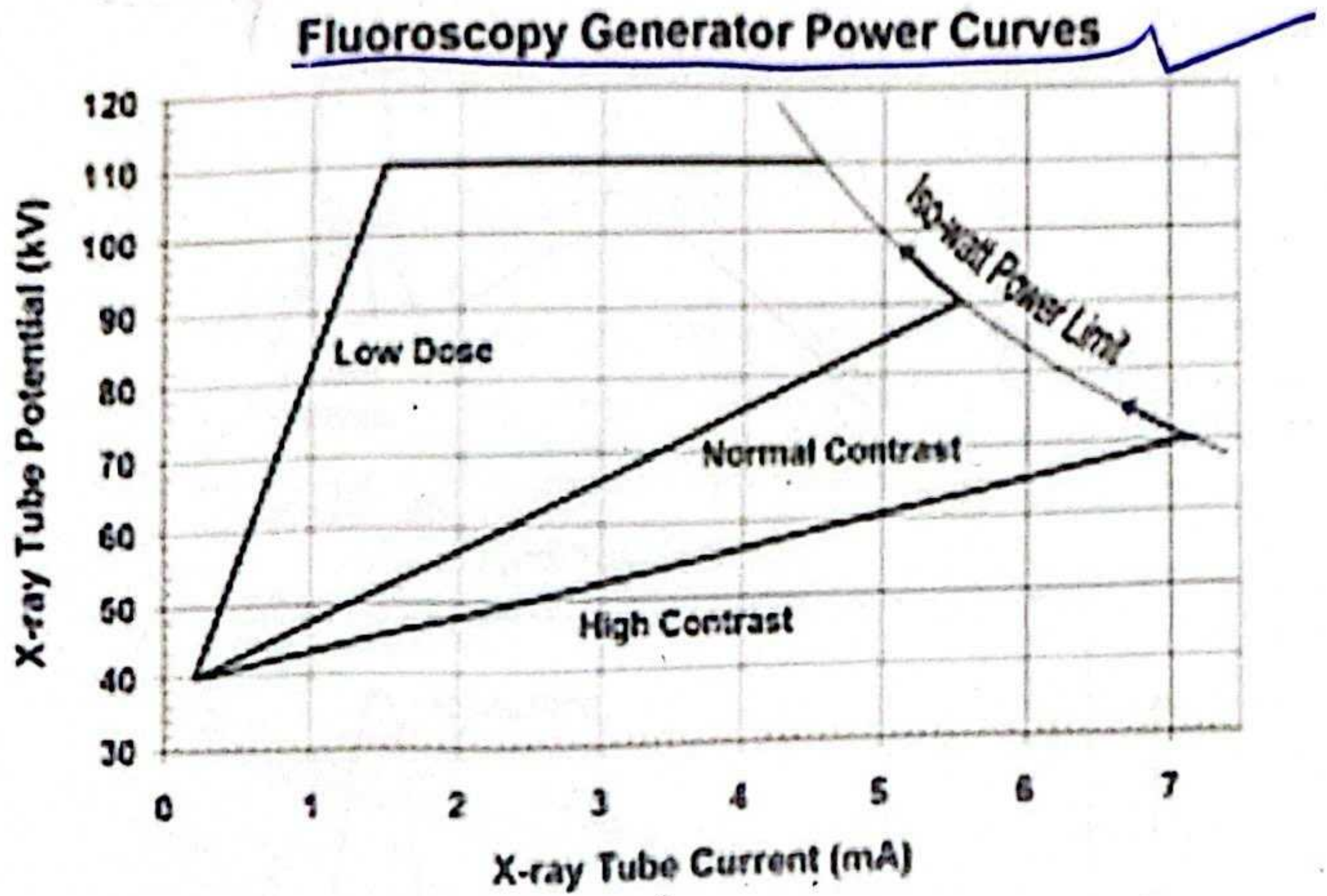


Figure 1.16 Mass attenuation coefficients as a function of energy. Photoelectric effect (τ/ρ, solid lines) for soft tissue, bone and iodine) and Compton effect (σ/ρ, dashed line) averaged for all tissues.

Q.3) **(2016)**



Isowatt Power Limit-Dose limit Curve

Pediatrics

- Normal Contrast standard
- High contrast
- Low Dose

Q.4)

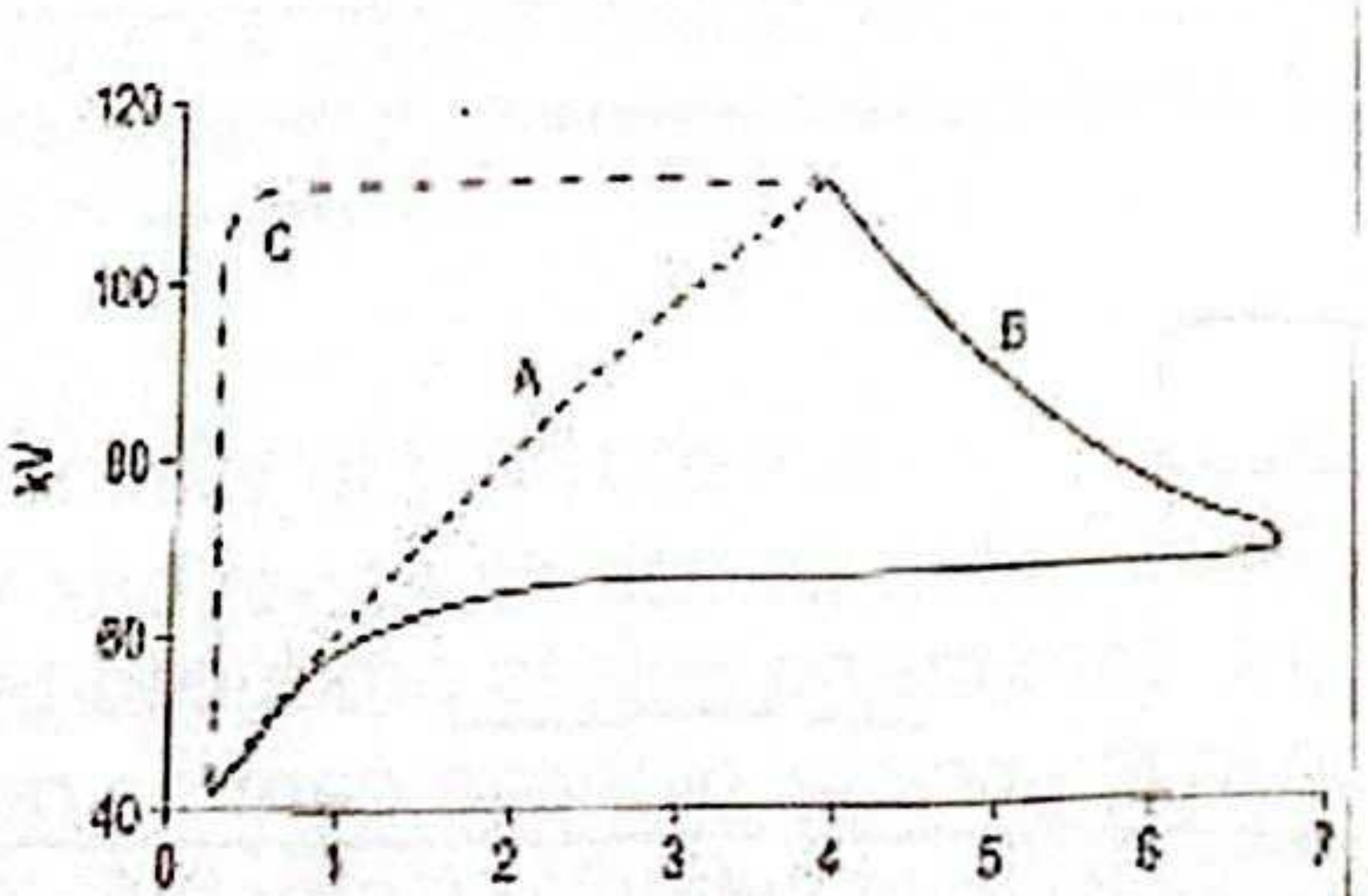
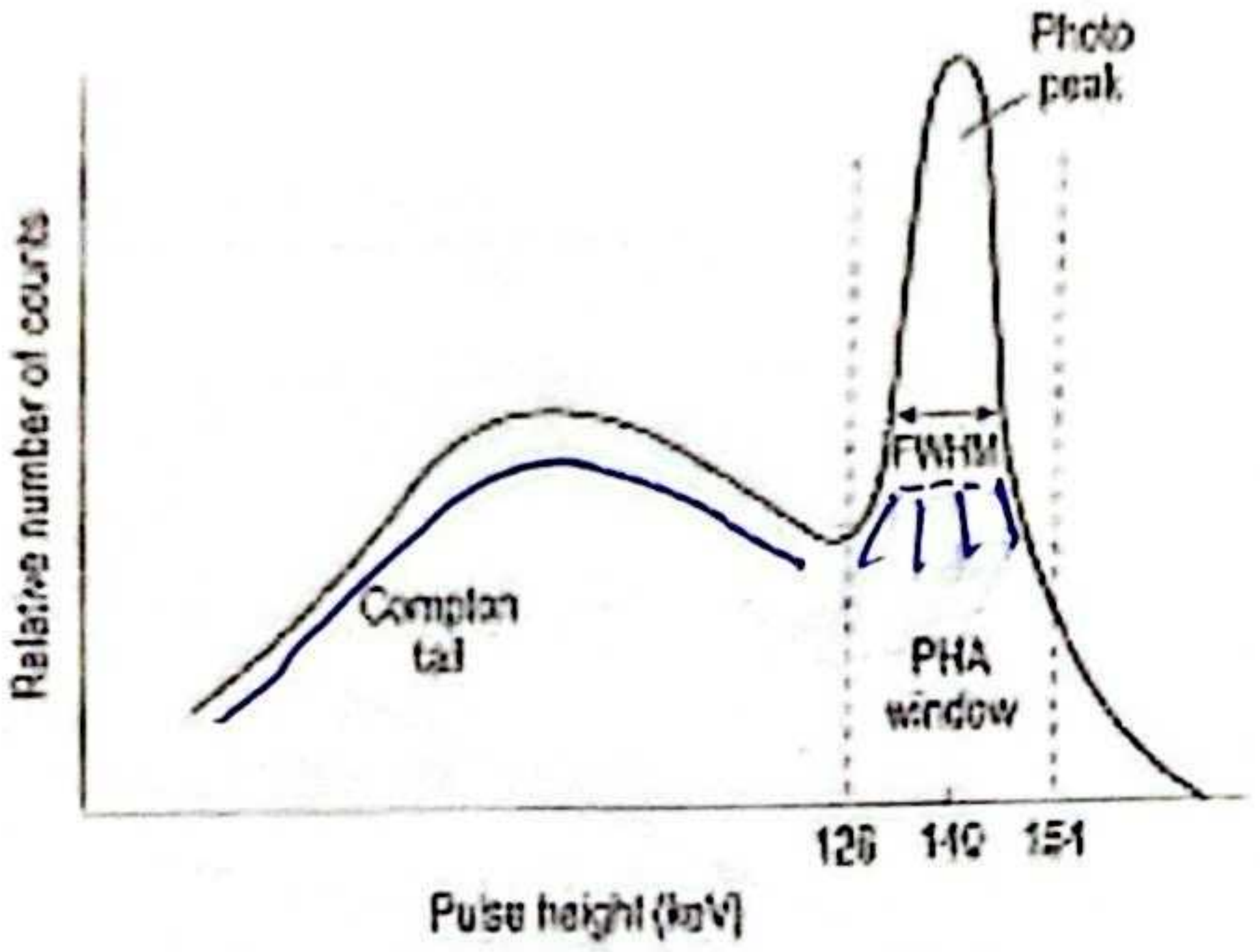


Figure 6.5 Relationship between kilovoltage (kV) and milliamperage used for automatic brightness control. Curve A is an anti-isowatt curve, curve B is optimized for iodine contrast imaging, and curve C is for low-dose high-kV fluoroscopy.

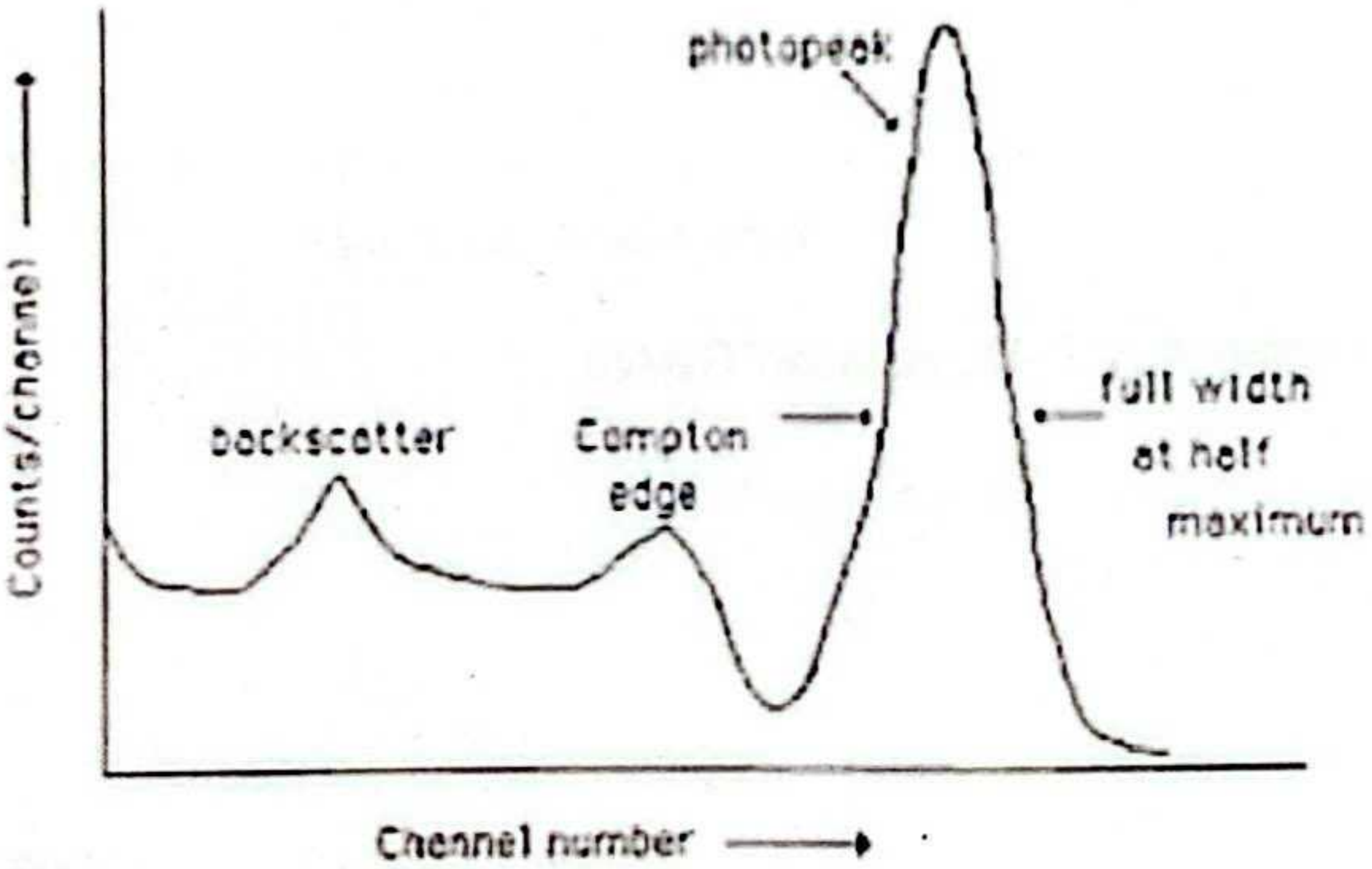
↑ Kv
↑ Penetri

In general, as radiological thickness increases it is necessary to increase kV to provide better penetration through the patient. Most commonly, mA is also increased with radiological thickness, as shown in curve A in Figure 6.5. This type of control curve is referred to as an anti-isowatt curve.

Q.5) **(2016)**



SR



PHS

Pulse height Spectrum

What causes photon peak?

A photopeak, on the right, comprising pulses produced by the complete photoelectric absorption in the crystal of those gamma ray photons that have come from the patient without suffering Compton scattering within the patient

What causes tail phenomenon?

A tail, on the left, containing pulses of lower energy, mostly produced by those gamma rays that have suffered Compton interactions in either the patient or the crystal

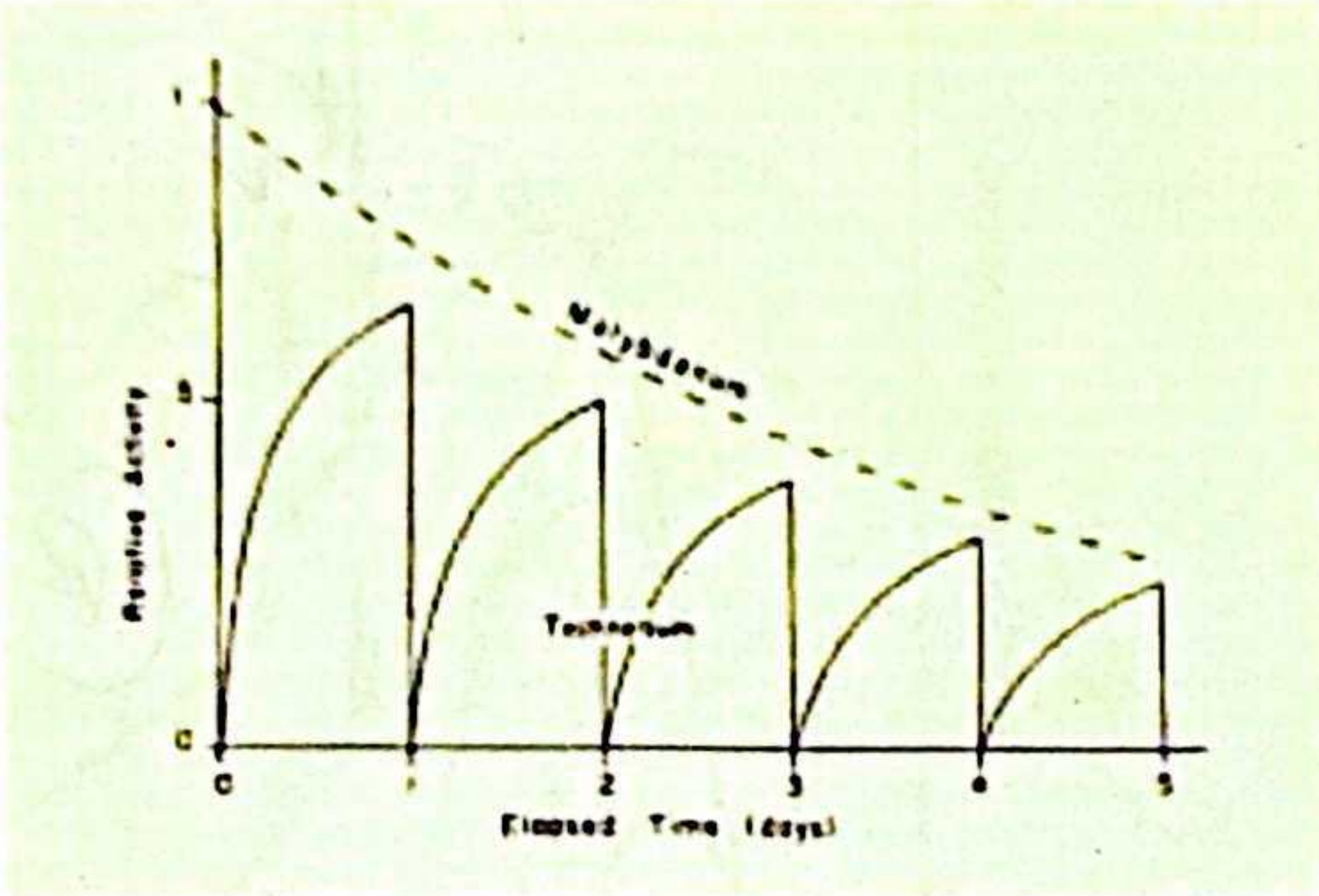
What is FWHM?

Full width of half maximum

The FWHM is a measure of the system resolution at the face of the collimator

500,000 or 1 million counts are required for each image frame.

Q.6) **(2015)**



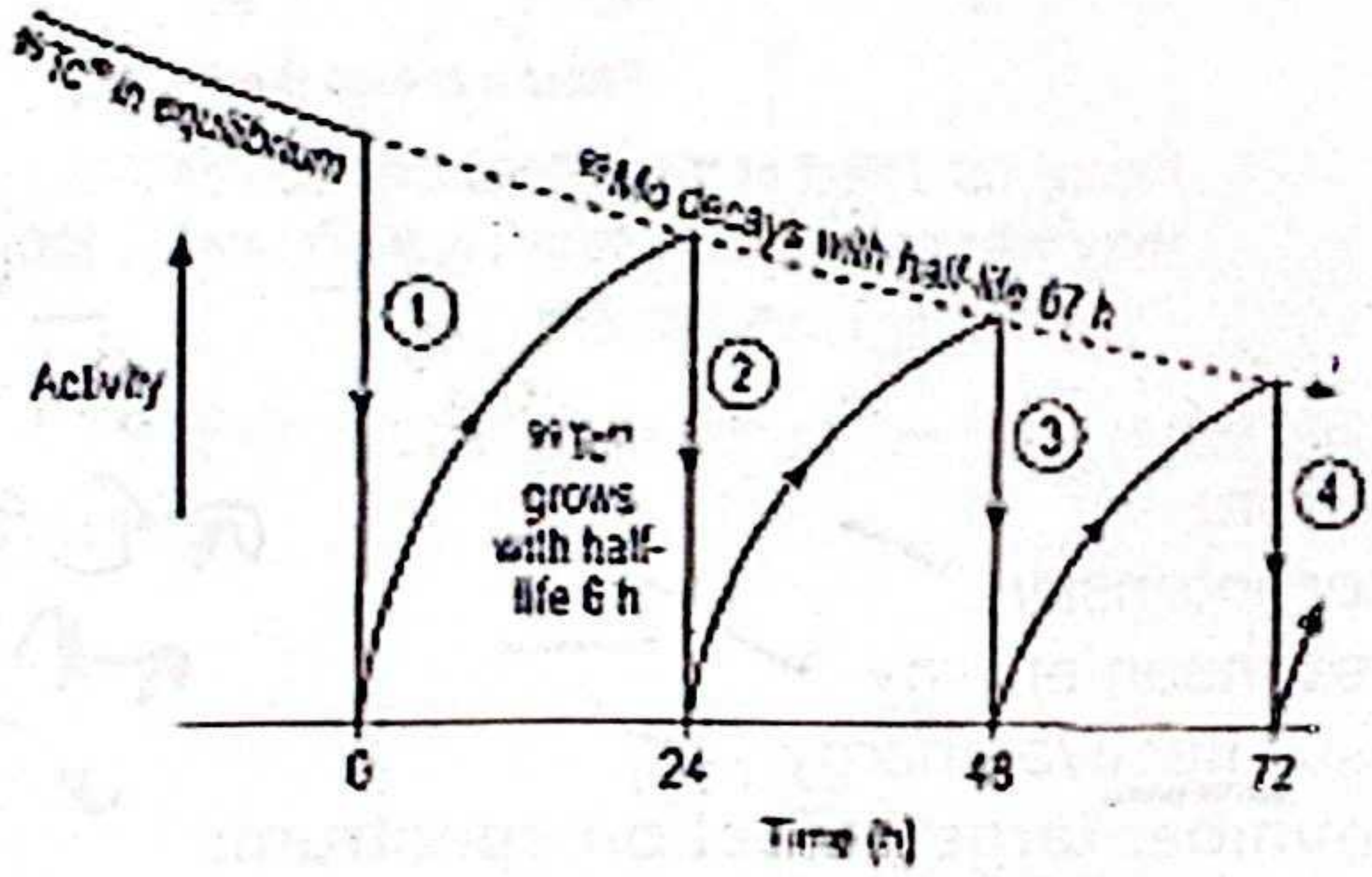


Figure 8.5 Decay of activity of molybdenum-99 and growth and regrowth of activity of technetium-99m in a generator that is eluted daily.

- Decay activity of molybdenum
- Growth and regrowth activity of technetium 99 #ND/s
- In a generator
- The activity of a radioactive sample is the rate of disintegration, the number of nuclei disintegrating per second.
- The SI unit is the becquerel (Bq)
- **Isomer** the metastable version of a nuclide (isomer) of a nuclide e.g. 99mTc is an isomer of 99Tc
- **Isotope** nuclides with the same number of protons (isotope) but with a different number of neutrons

Quantity	SI Unit	Conventional Unit	Ratio of SI to Conventional
Exposure	Coulomb/kilogram (C/kg)	Roentgen (R)	2.58×10^{-4} C/kg = 1 R
Dose	Gray (Gy)	rad	1 Gy = 100 rad
Effective Dose	Sievert (Sv)	rem	1 Sv = 100 rem
Activity	Becquerel (Bq)	Curie (Ci)	3.7×10^{10} Bq = 1 Ci

Q.7)

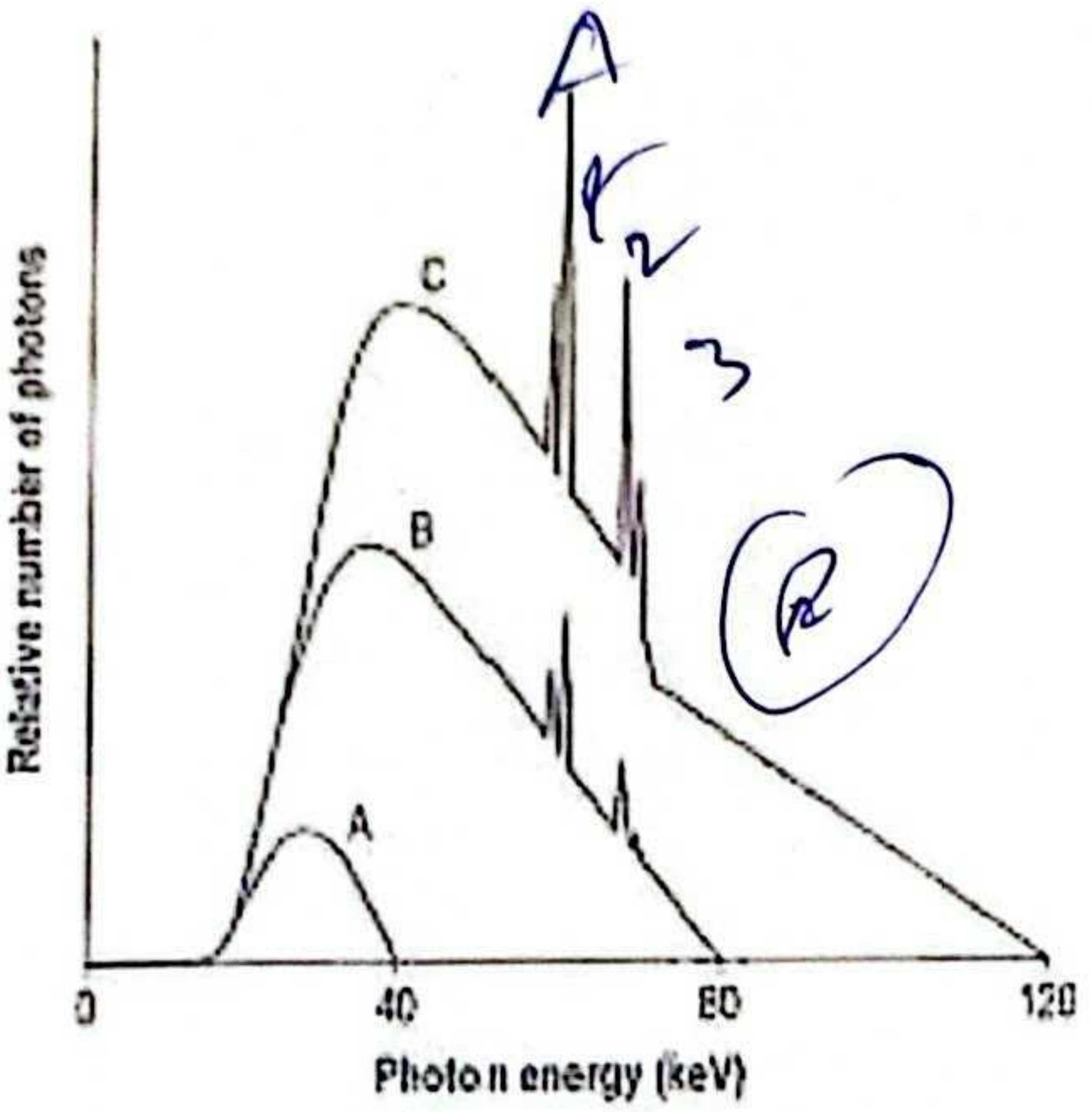


Figure 1.9 Effect of tube kilovoltage (kV) on X-ray spectra for three tube potentials: A, 40 kV; B, 80 kV; and C, 120 kV.

Effect of filtration:

1. Reduced intensity ✓
2. Increase mean energy ✓
3. Increase effective energy ✓

↑EE
↑ME
↓I

✓ **High atomic number target effect on spectrum:**

1. X-ray emission spectrum shits towards right side.
2. Increase in amplitude ✓
3. Photon energies of charectristic lines will be more

The efficiency of X-ray production is the ratio X-ray output electrical power supplied and increases with the kV. The efficiency is also greater the higher the atomic number of the target.

o Increasing the kV shifts the spectrum upwards and to the right, as shown in Figure 1.9. It increases the maximum and effective energies and the total number of X-ray photons. Below a certain kV (70 kV for a tungsten target), the characteristic K-radiation is not produced.

o Increasing the mA does not affect the shape of the spectrum but increases the output of both bremsstrahlung and characteristic radiation proportionately.

o Changing the target to one of lower atomic number reduces the output of bremsstrahlung but does not otherwise affect its spectrum, unless the filtration is also changed. The photon energy of the characteristic lines wil also be less.

o Whatever the kV waveform (see Fig. 1.5), the maximum and minimum photon energies are unchanged.

Q.8)

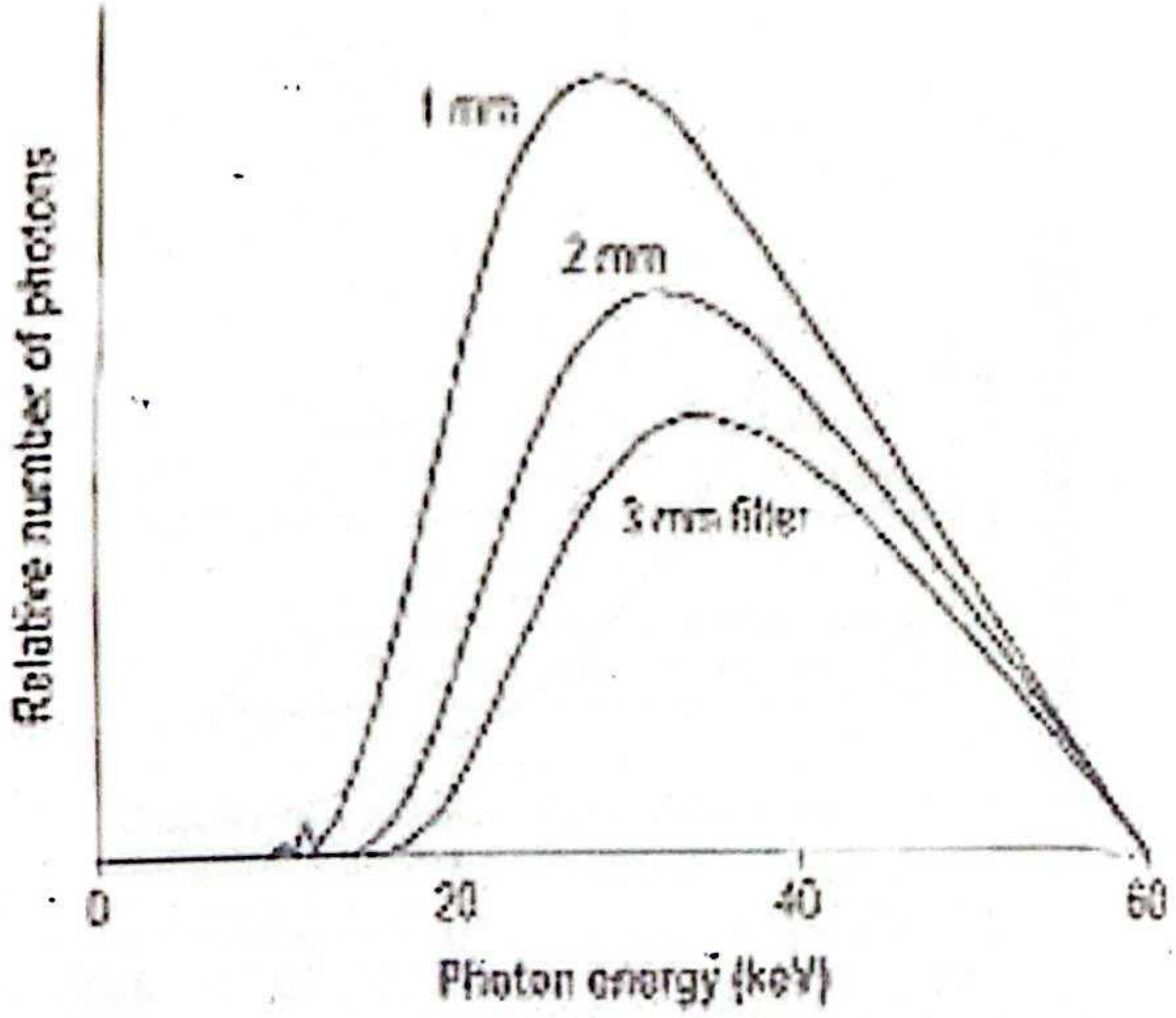


Figure 1.18 Effect of increasing aluminium filtration on the X-ray spectrum.

It therefore increases the penetrating power (HVL) of the beam at the-cost of reducing its intensity. It reduces the skin dose to the patient while having little effect on the radiological image.

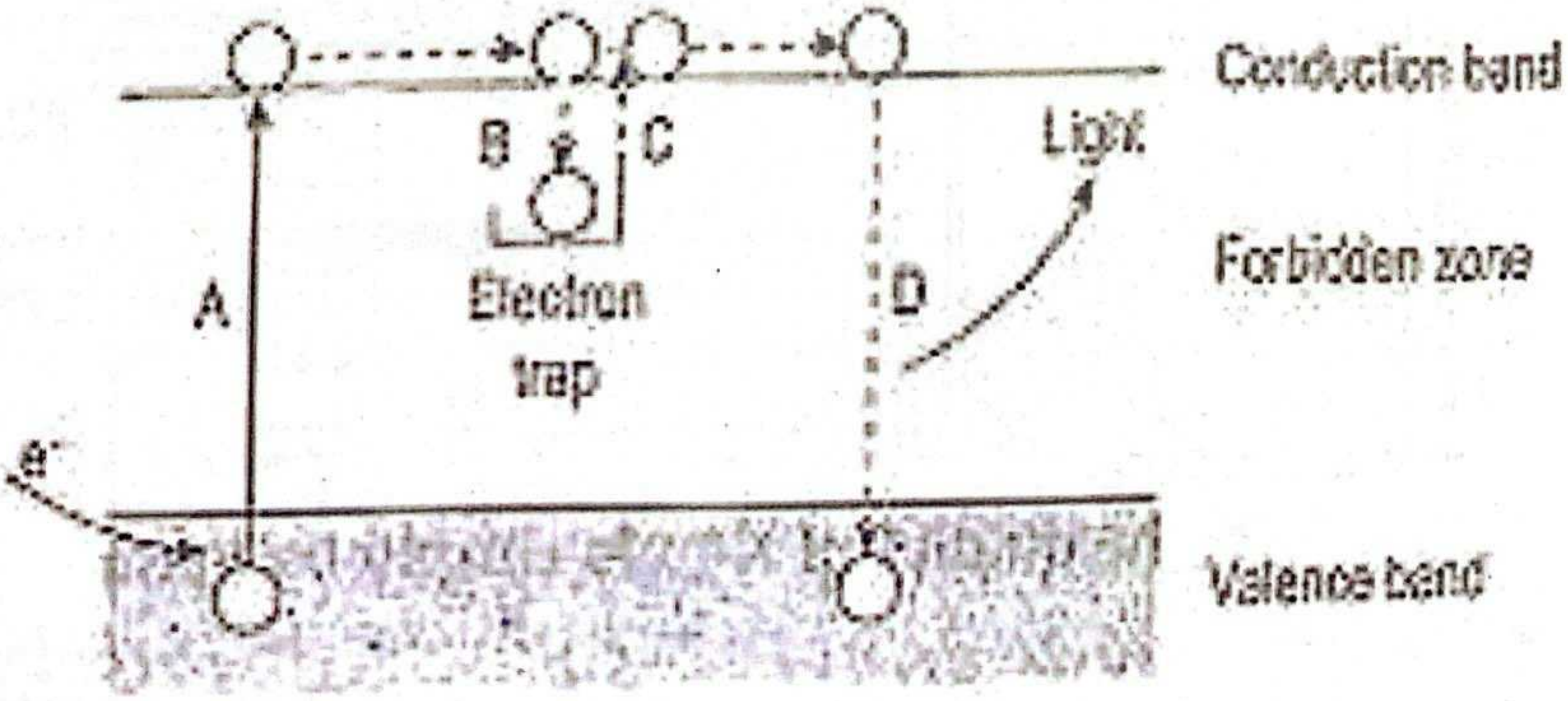

Conduction band
B
C
Light
A
Electron trap
D
Forbidden zone
e⁻
Valence band

Figure 1.21 Luminescence caused by ionizing radiation.

Increasing the kV therefore reduces the skin dose incurred in producing satisfactory image and, to a lesser extent, the dose to deeper tissues.

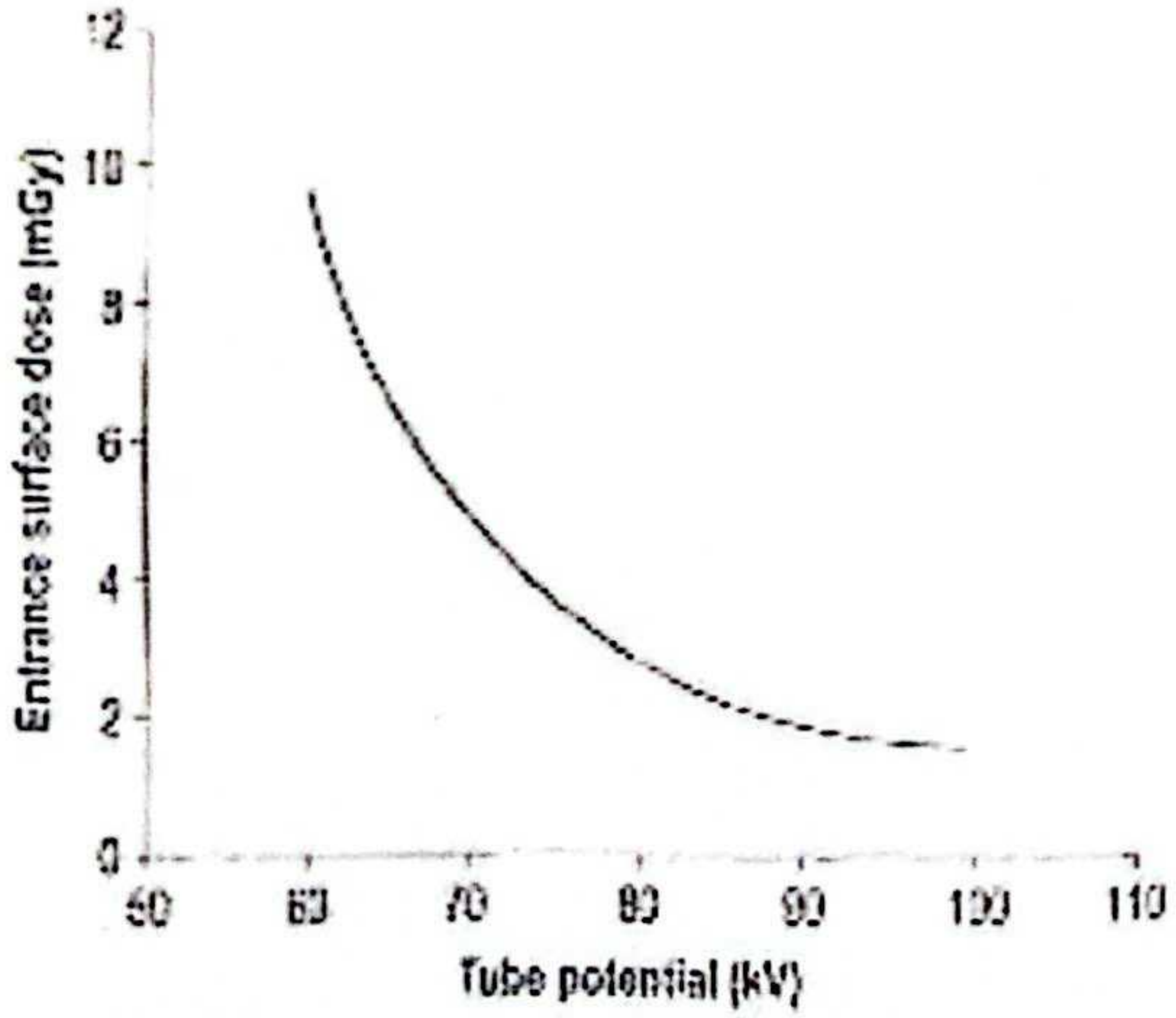


Figure 3.6 The variation of entrance surface dose with kilovoltage.

The spectrum of X-ray energies from a molybdenum target using a molybdenum filter, with the spectrum from a tungsten target with aluminium filter superimposed (dashed line).

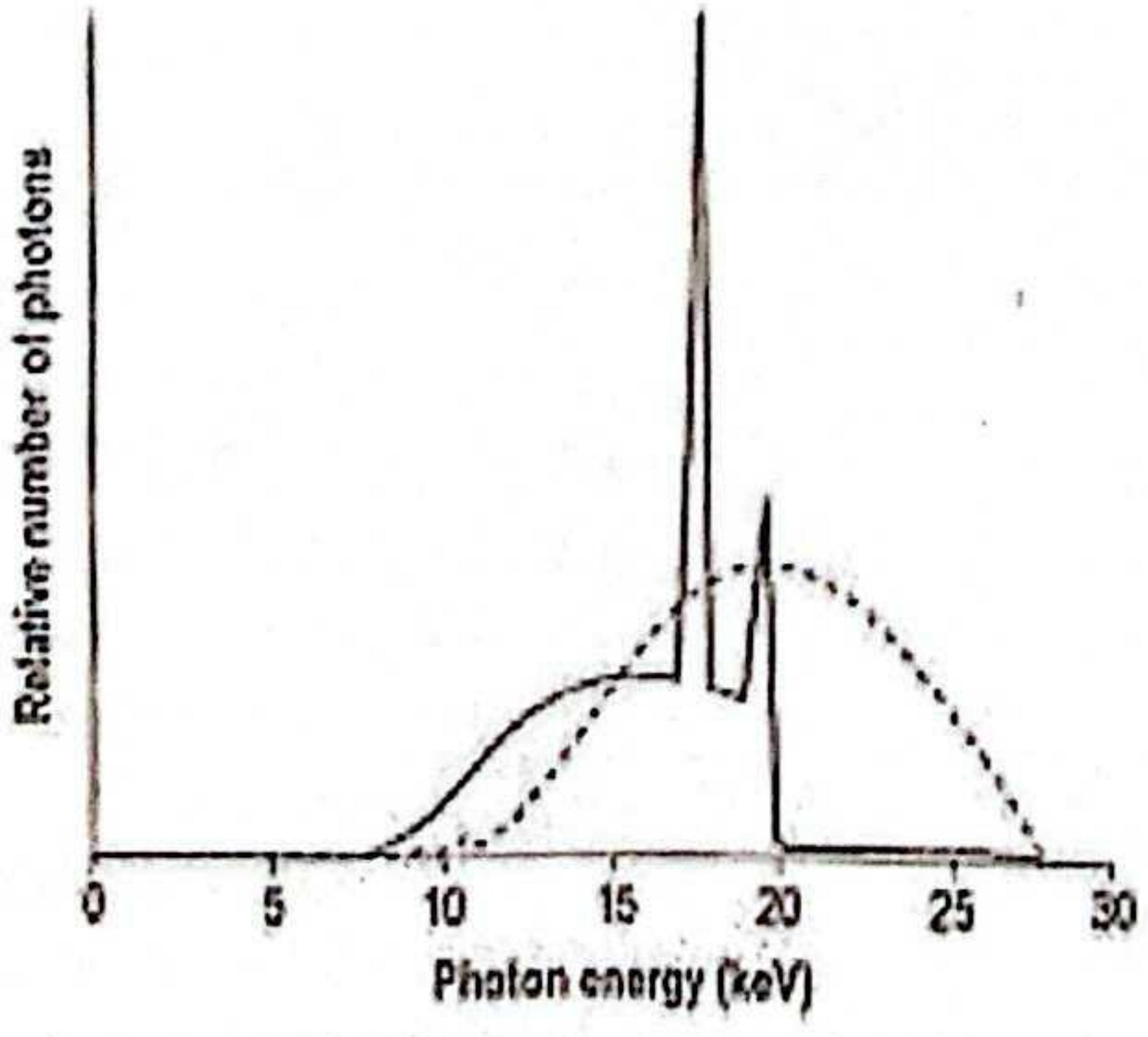


Figure 4.7 The spectrum of X-ray energies from a molybdenum target using a molybdenum filter, with the spectrum from a tungsten target with aluminium filter superimposed (dashed line).

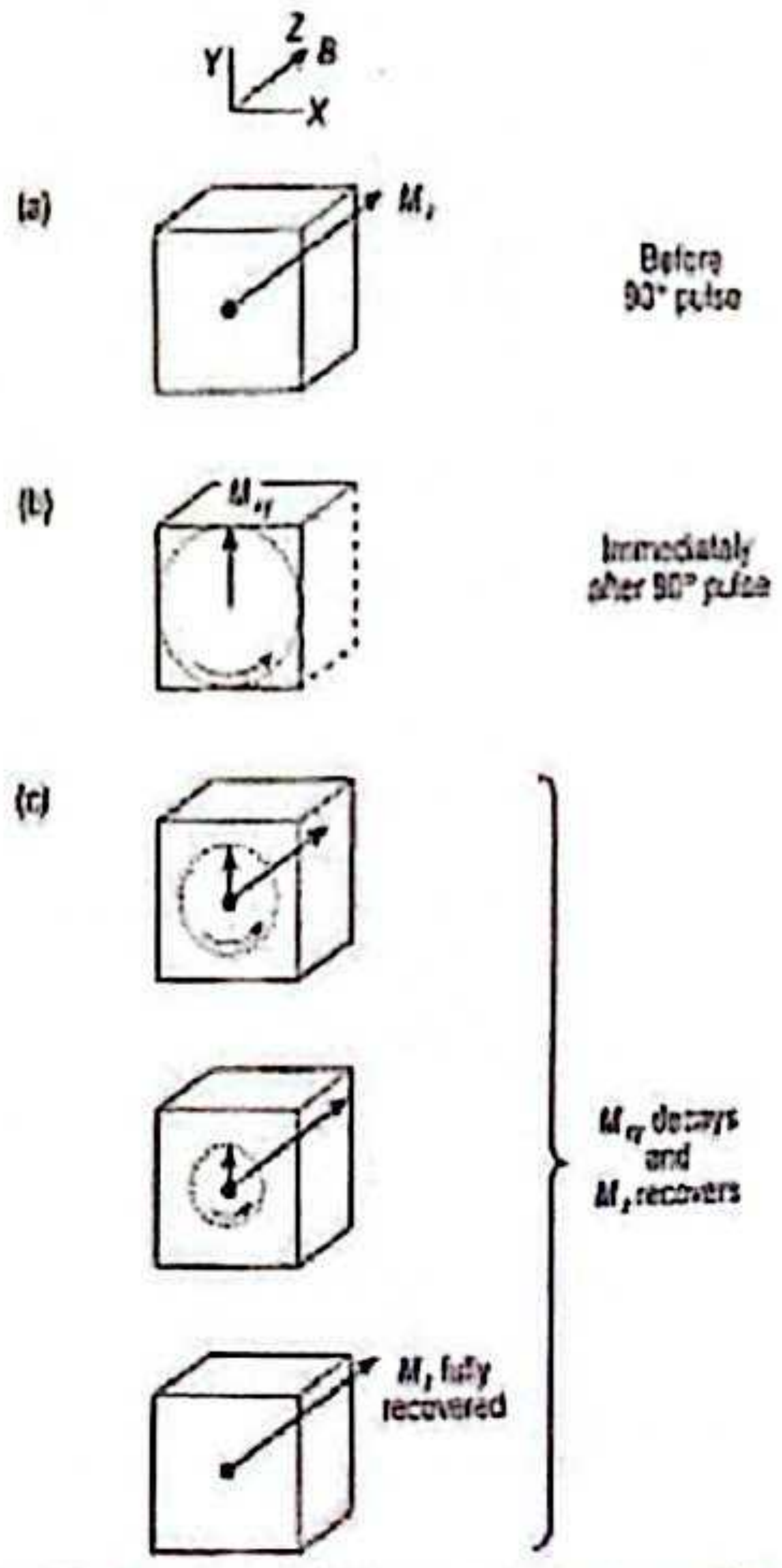

Y
Z
B
X
(a)
M_z
Before 90° pulse
(b)
M_{xy}
Immediately after 90° pulse
(c)
M_{xy} decays and M_z recovers
M_z fully recovered

Figure 10.3 The net magnetization in a tissue voxel: a time sequence following a 90° pulse.

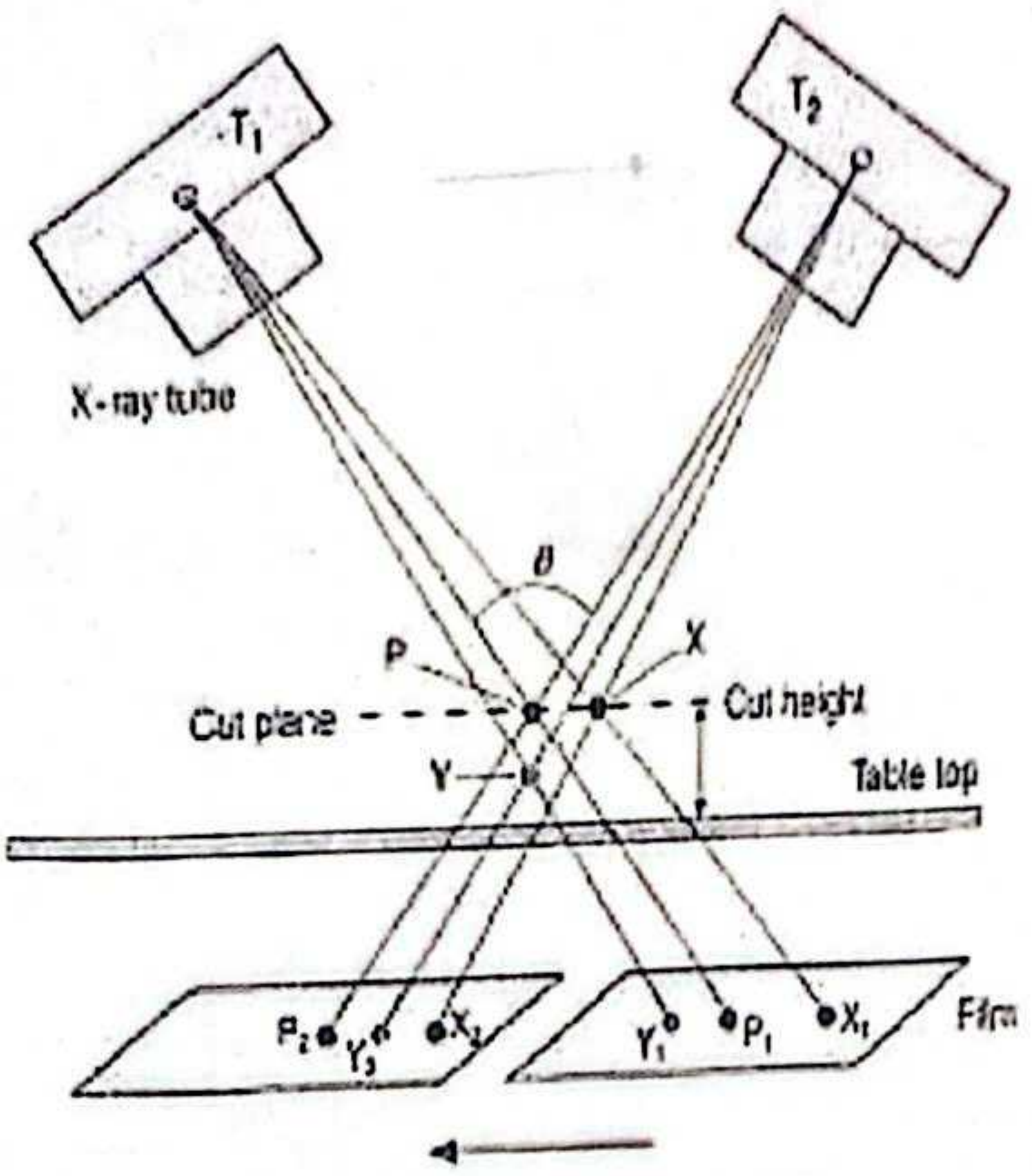

T1
T2
X-ray tube
θ
P
X
Cut plane
Y
Cut height
Table top
P2
Y2
X2
Y1
P1
X1
Film

Figure 4.9 The principles of image formation in linear tomography.

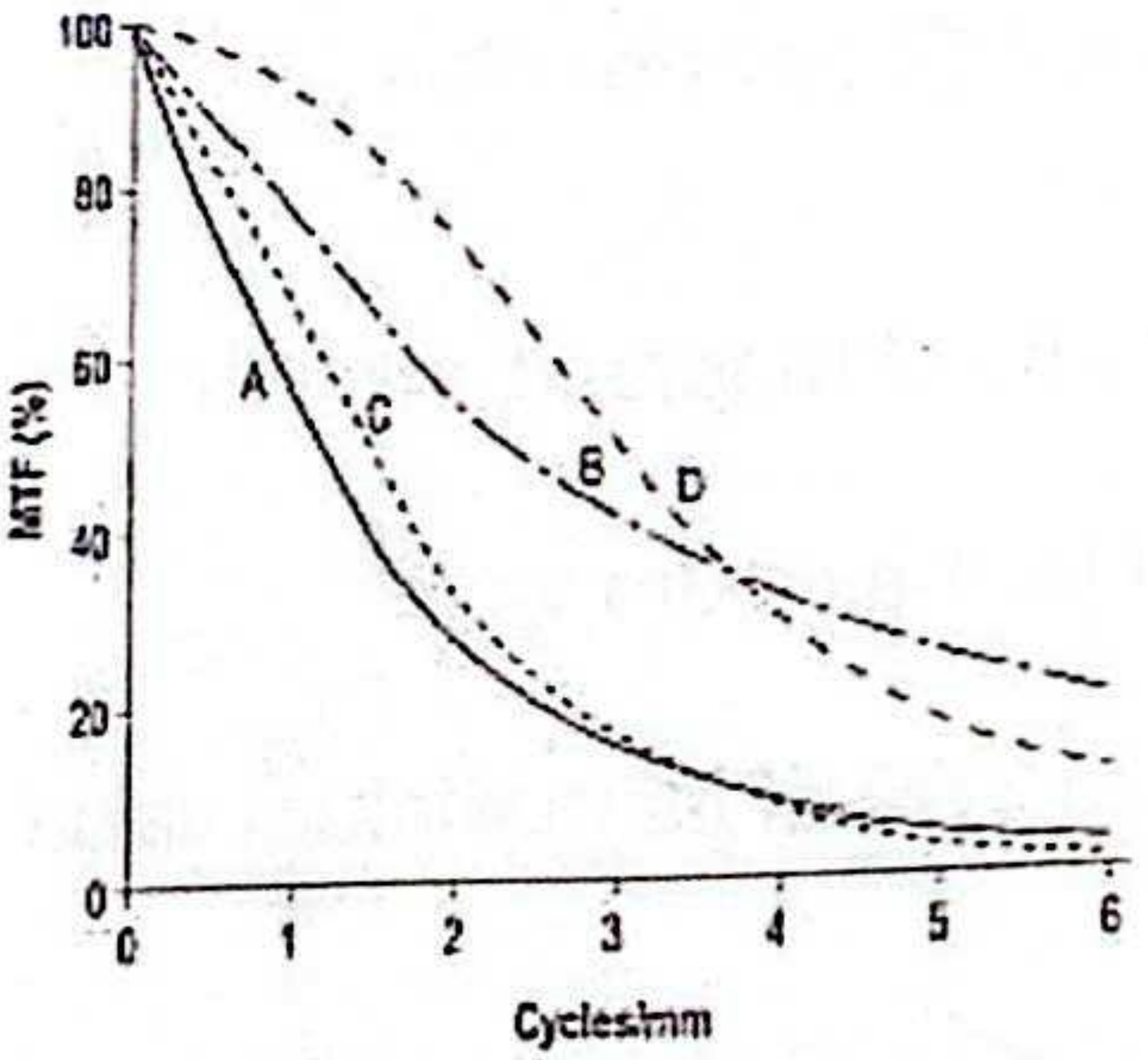


Figure 5.4 Modulation transfer function (MTF) as a function of spatial frequency for various radiographic systems: A, 400-speed film-screen system; B, detail film-screen system used for extremity imaging; C, computed radiography; and D, direct digital radiography.

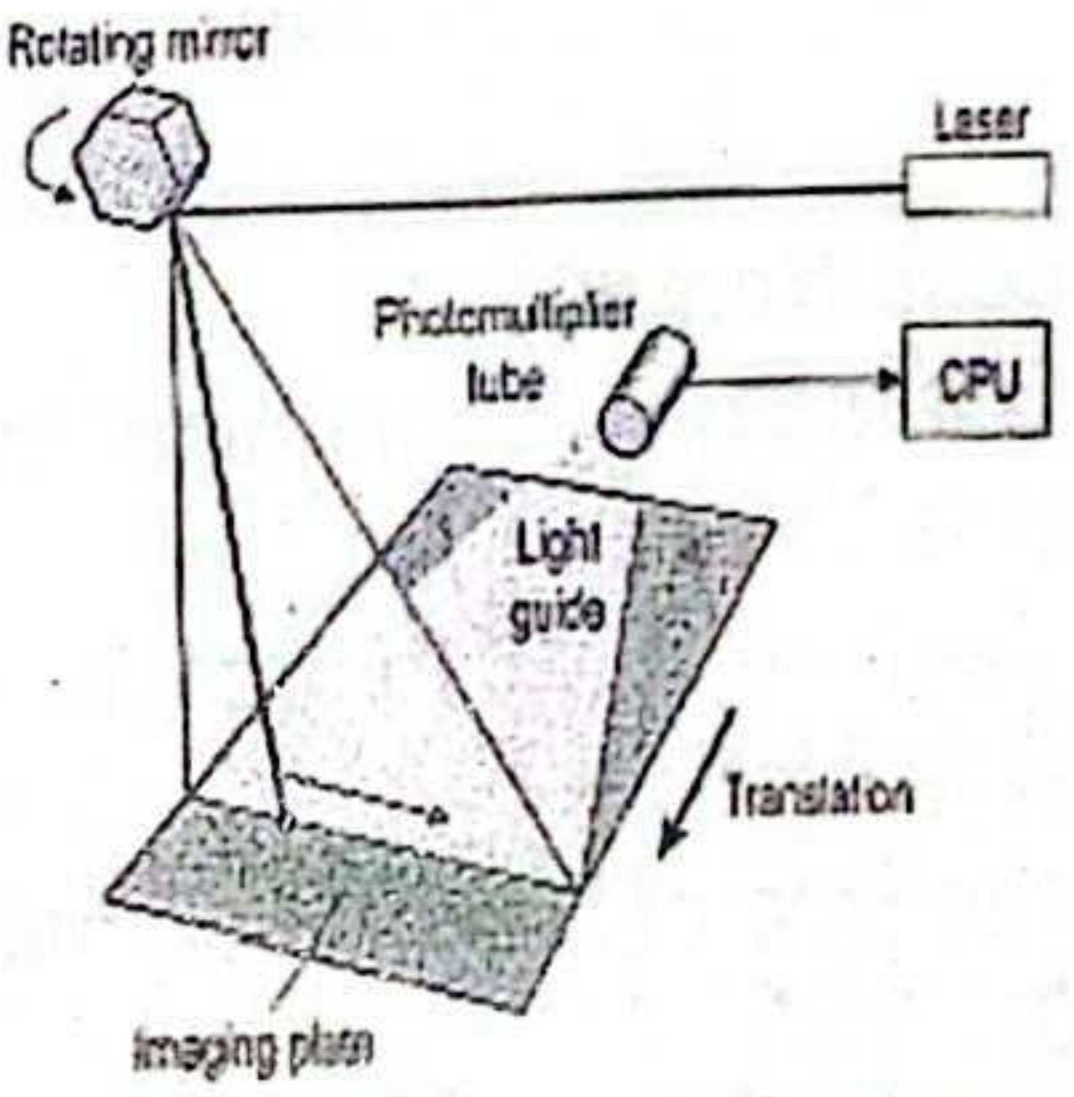

Rotating mirror
Laser
Photomultiplier tube
CPU
Light guide
Translation
Imaging plate

Figure 5.5 Formation of the computed radiography image using a scanned laser beam. CPU, central processing unit.

can be extracted. Most phosphors used for CR emit light at the blue end of the spectrum and need a scanning laser emitting red light for simulation.

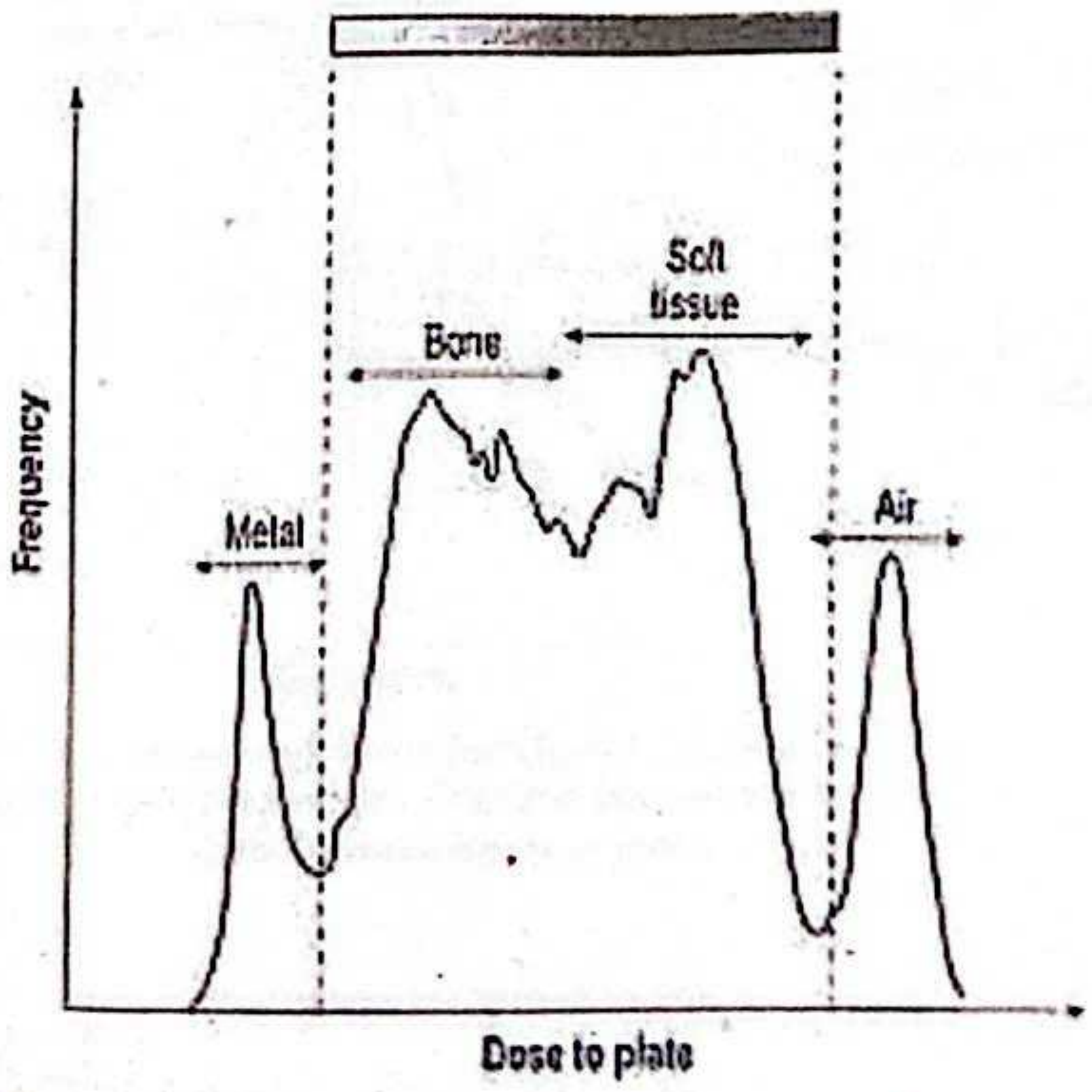
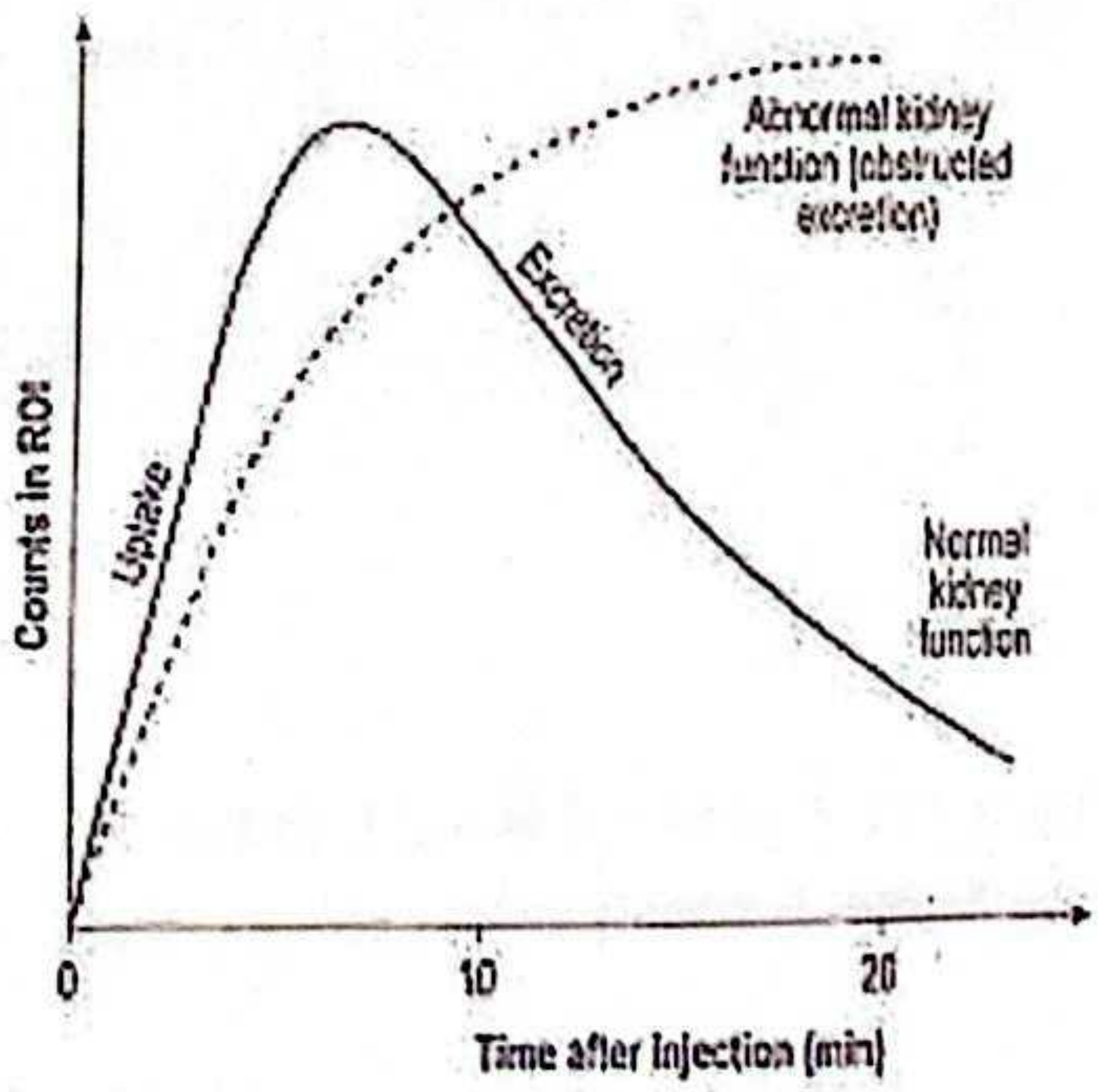


Figure 5.7 Distribution of signals from the computed radiography plate as a function of dose.



igure 8.12 Renogram using iodine-123-labelled hippuran. OI, region of interest.

Q.9)

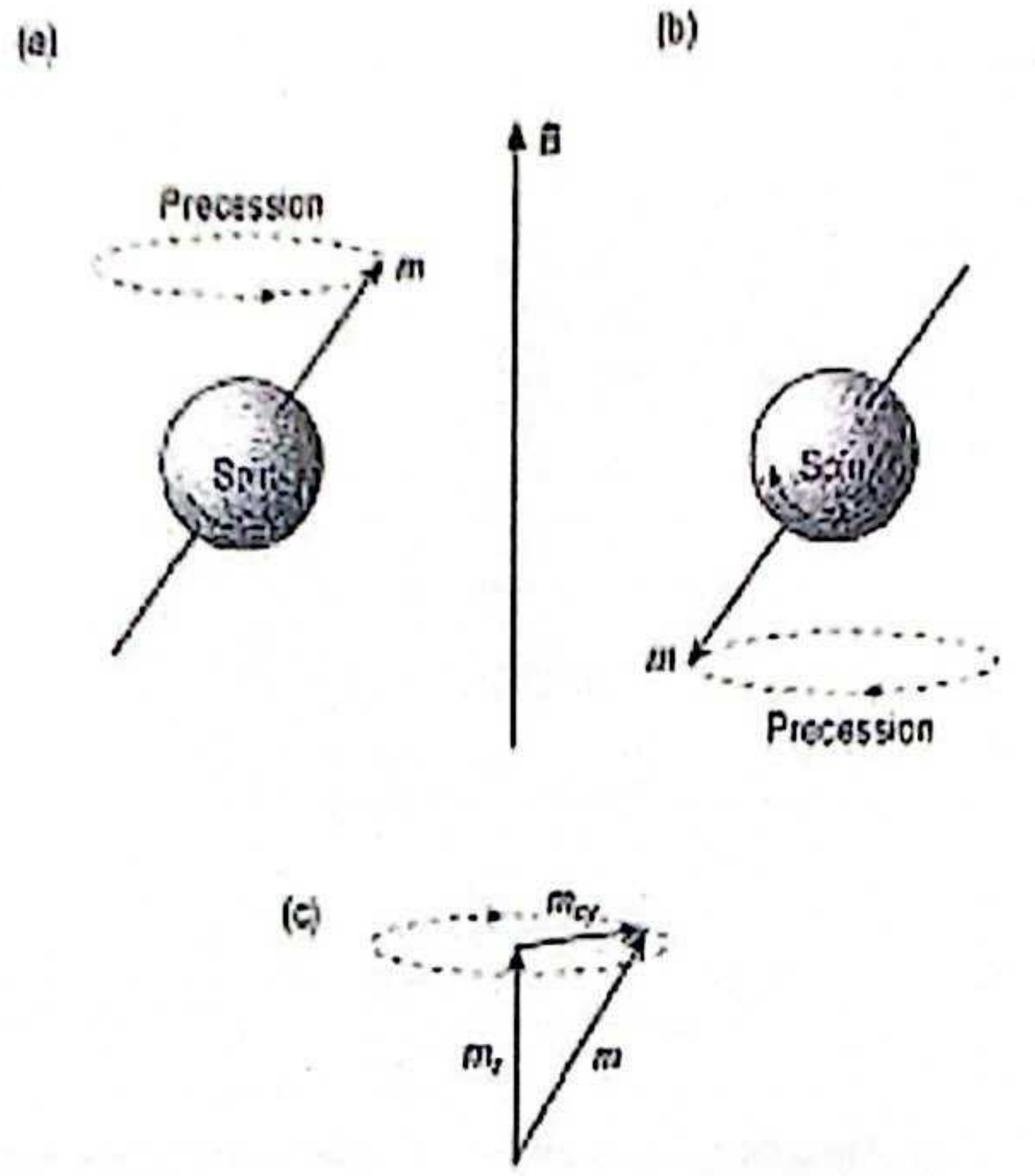


Figure 10.1 The magnetic vectors associated with a spinning proton processing (a) parallel and (b) antiparallel to a magnetic field, *B*. (c) The transverse and longitudinal components of the magnetic vector.

Process Name:

Transverse and longitudinal components of magnetic vectors

What is T1 time?

It is the time of MZ to recover 63% of its maximum value.

What is T2 time?

It is the time of Mxy MR signal to fall to 37% of its maximum value.

Q.10)

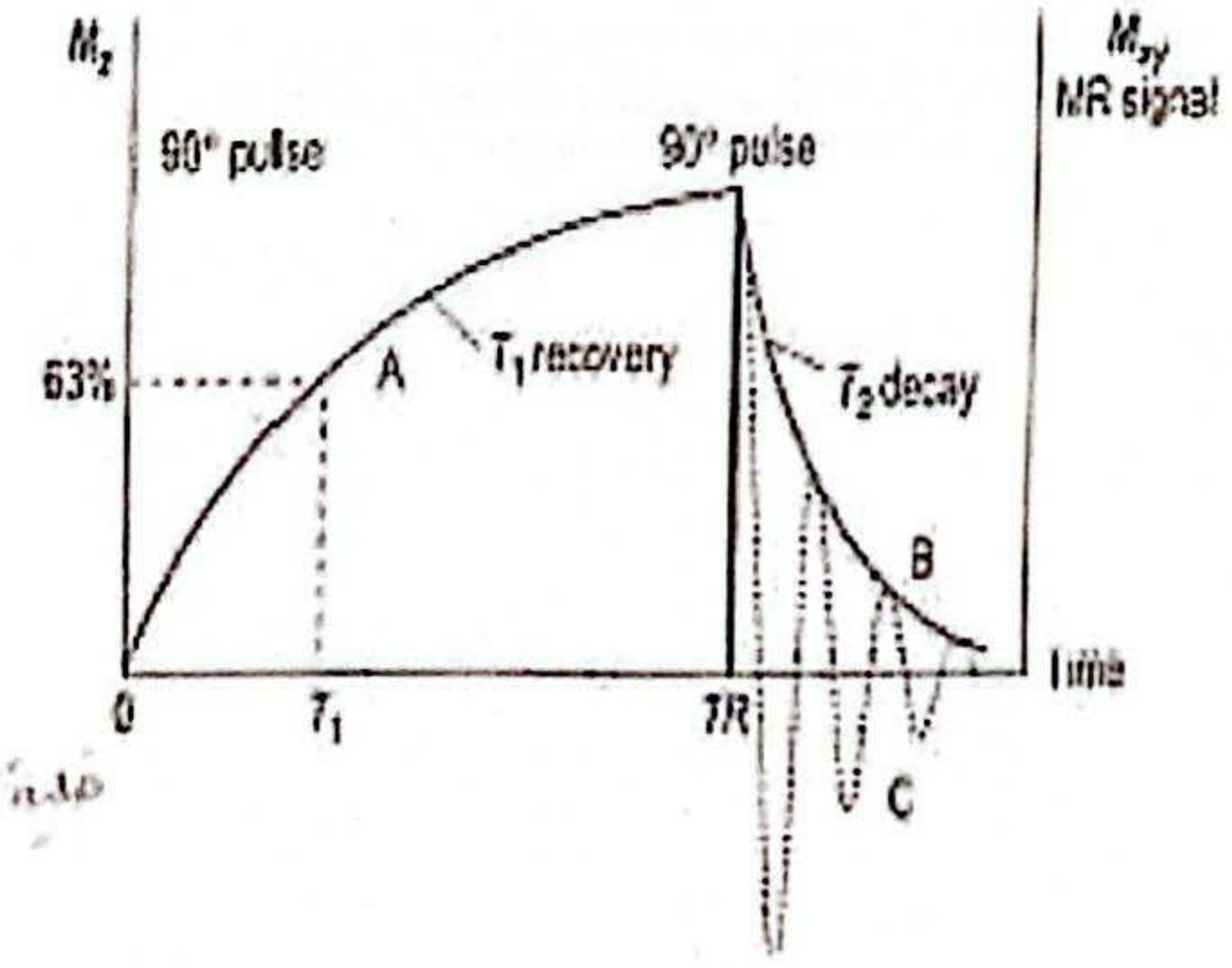


Figure 10.5 T_1 recovery of M_z and T_2 decay of M_{xy}. MR, magnetic resonance

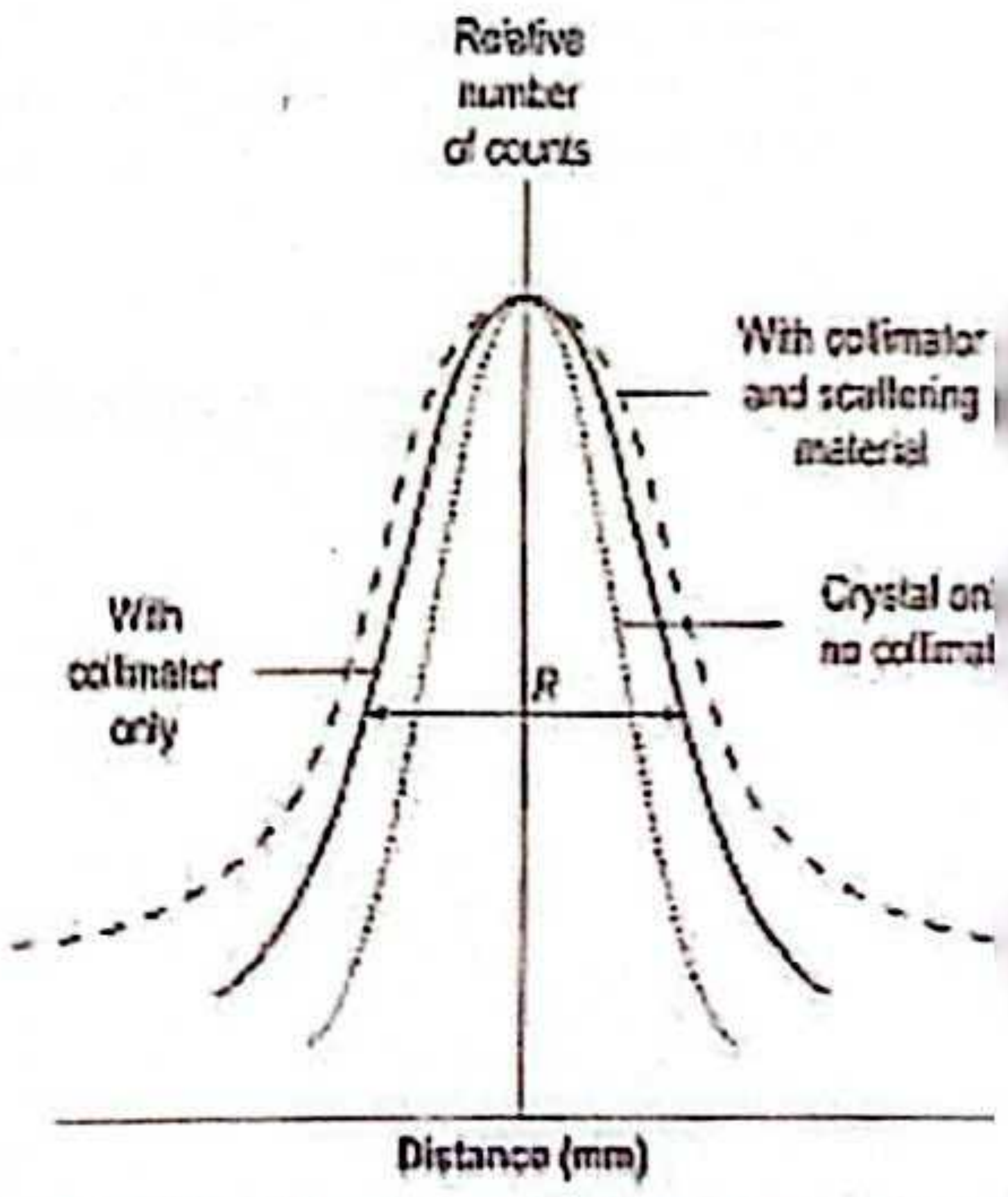


Figure 8.25 Spatial resolution of a gamma camera (poin spread function) under different conditions. (Each curve is plotted relative to its own maximum value.)

Q.11)

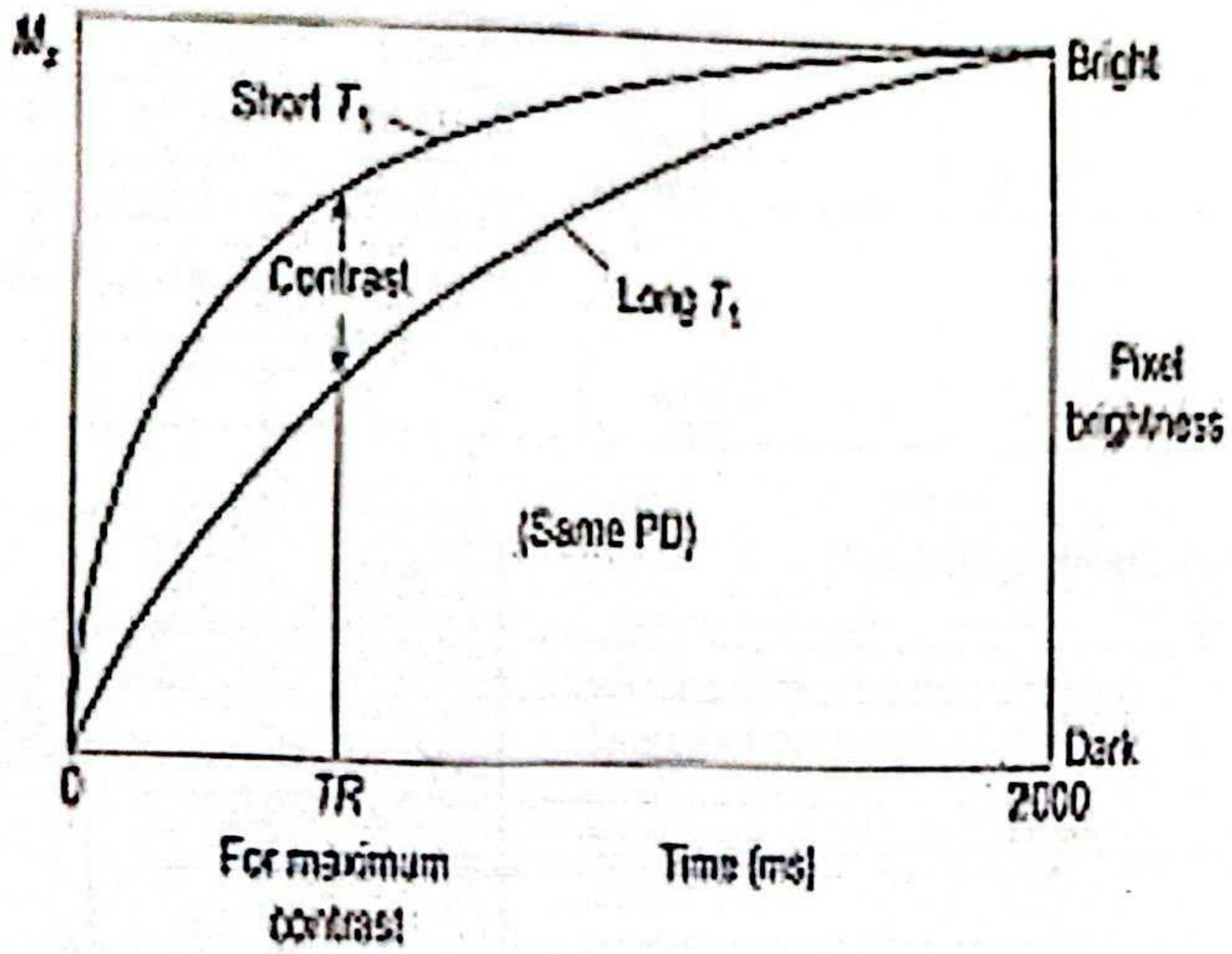


Figure 10.8 T_1 contrast.
PD, proton density; *TR*, repetition time.

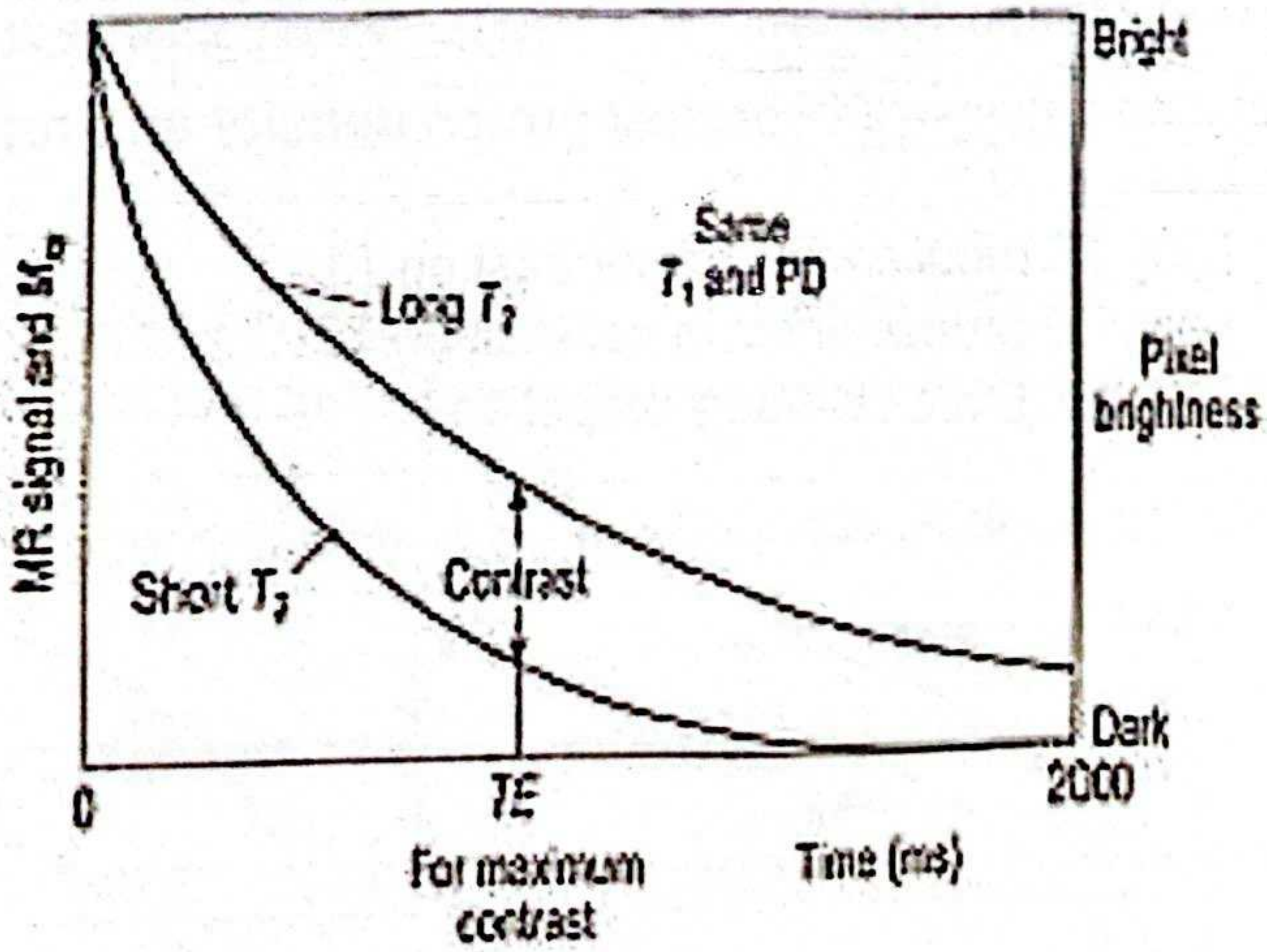


Figure 10.9 T_2 contrast.
MR, magnetic resonance; PD, proton density; *TE*, echo time.

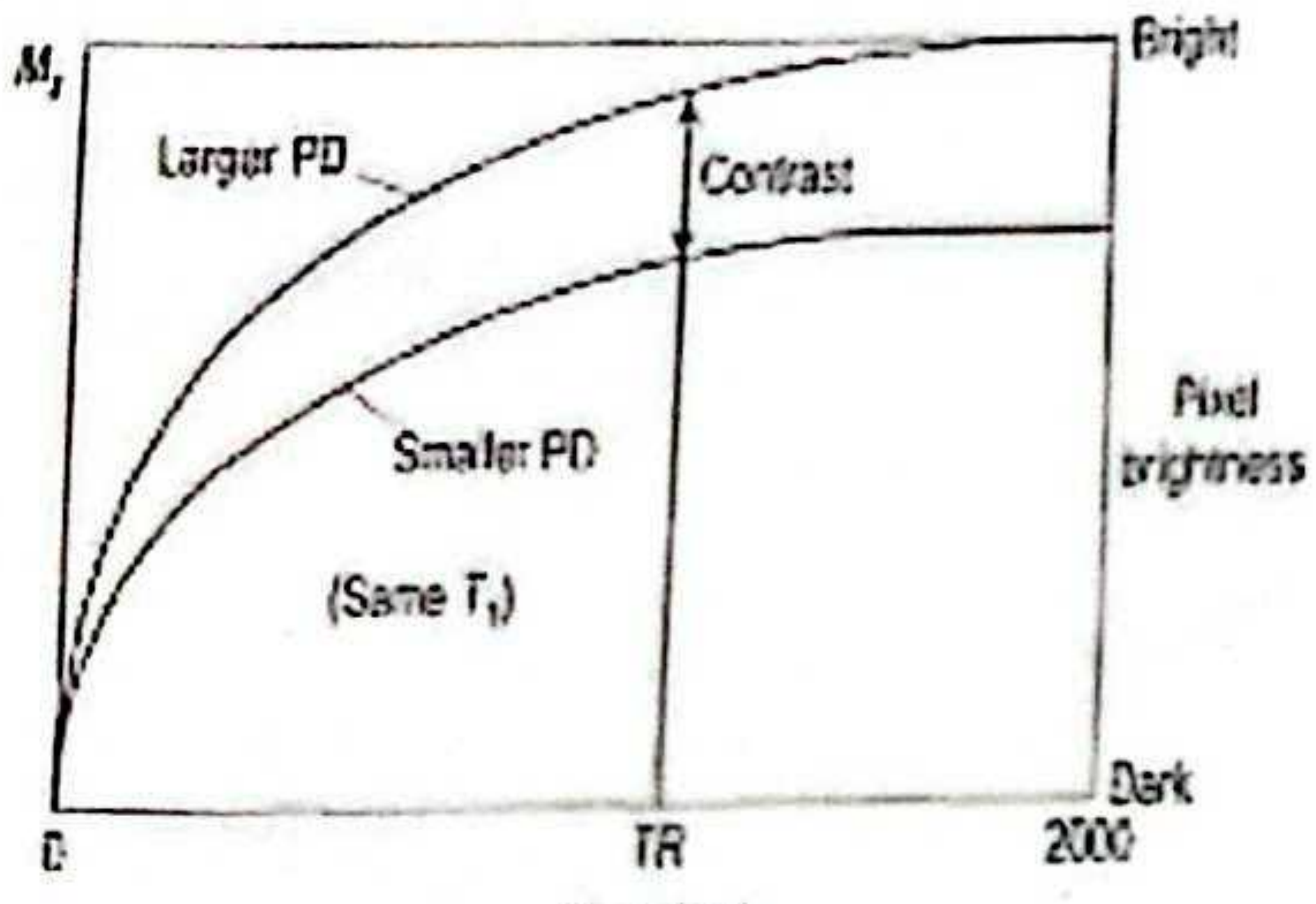


Figure 10.10 Proton density (PD) contrast. *TR*, repetition time.

different T_2. However, it must not be so long that the signal is so small as to be obscured by background noise.

A relatively long *TE* of 90–140 ms is used – about the same as the average T_2 of the tissues of interest. A long *TR* (1000–2000 ms) is also used, as this reduces the effect of T_1 on contrast, although unfortunately it increases the imaging time.

Image contrast is then principally caused by differences in the T_2 decay properties of the tissues. The longer is T_2, the stronger the signal and the brighter the pixel. *Water and CSF appear brighter than fat.*

Table 10.2 T_1-, T_2- and proton density-weighting effects

Weighting	Properties	Result
T_1-weighted	*TR* and *TE* both short	Short T_1 = bright
T_2-weighted	*TE* and *TR* both long	Long T_2 = bright
PD-weighted	Short *TE* and long *TR*	High PD = bright

PD, proton density; *TE*, echo time; *TR*, repetition time.

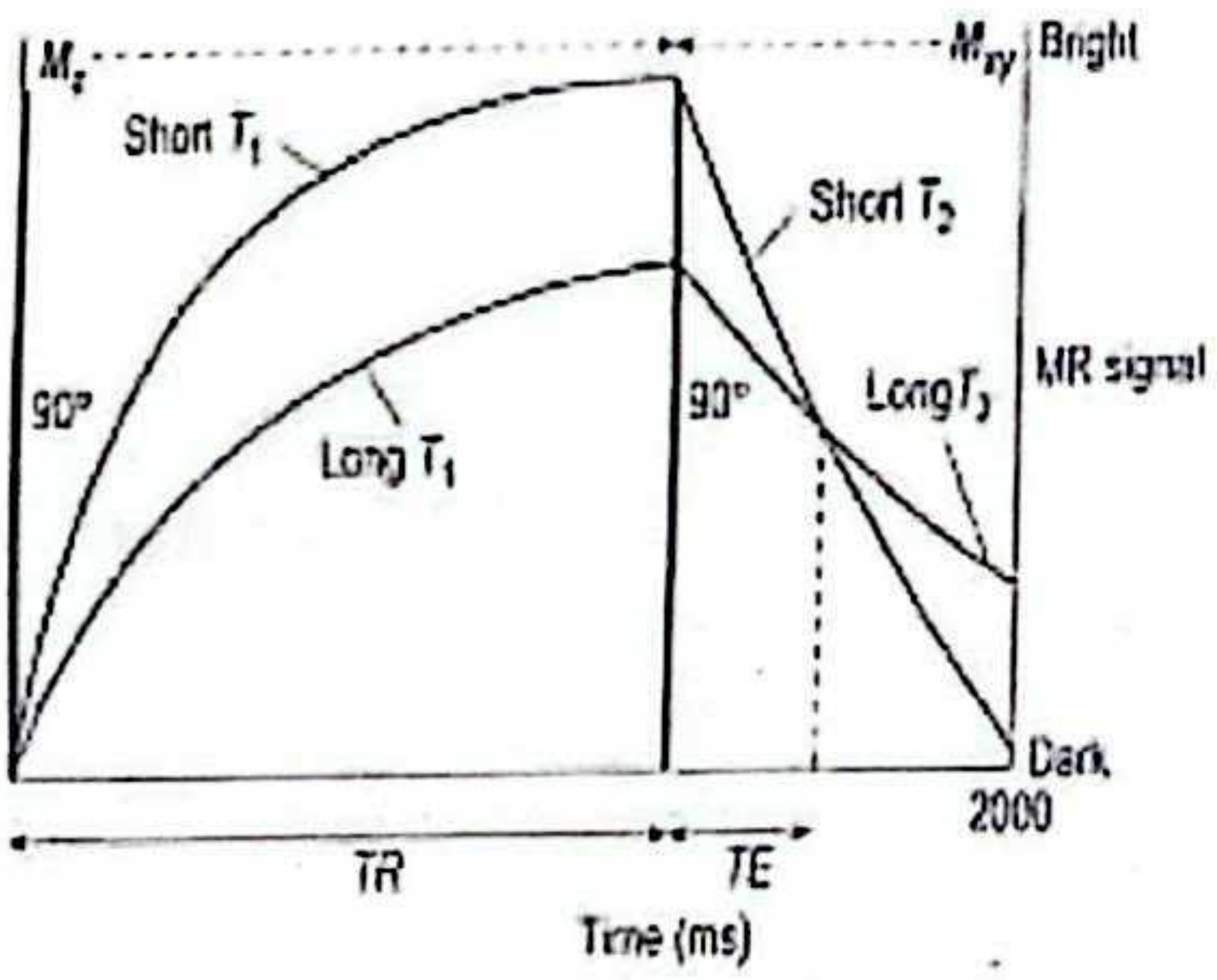


Figure 10.11 Contrast: combined effects of T_1 and T_2. MR, magnetic resonance; *TE*, echo time; *TR*, repetition time.

Association between T1 contrast proton density and repetition time TR

- Long TR reduce effect of contrast on T1
- Short TE reduce effect of contrast on T2
- TR and TE are inversely propotion

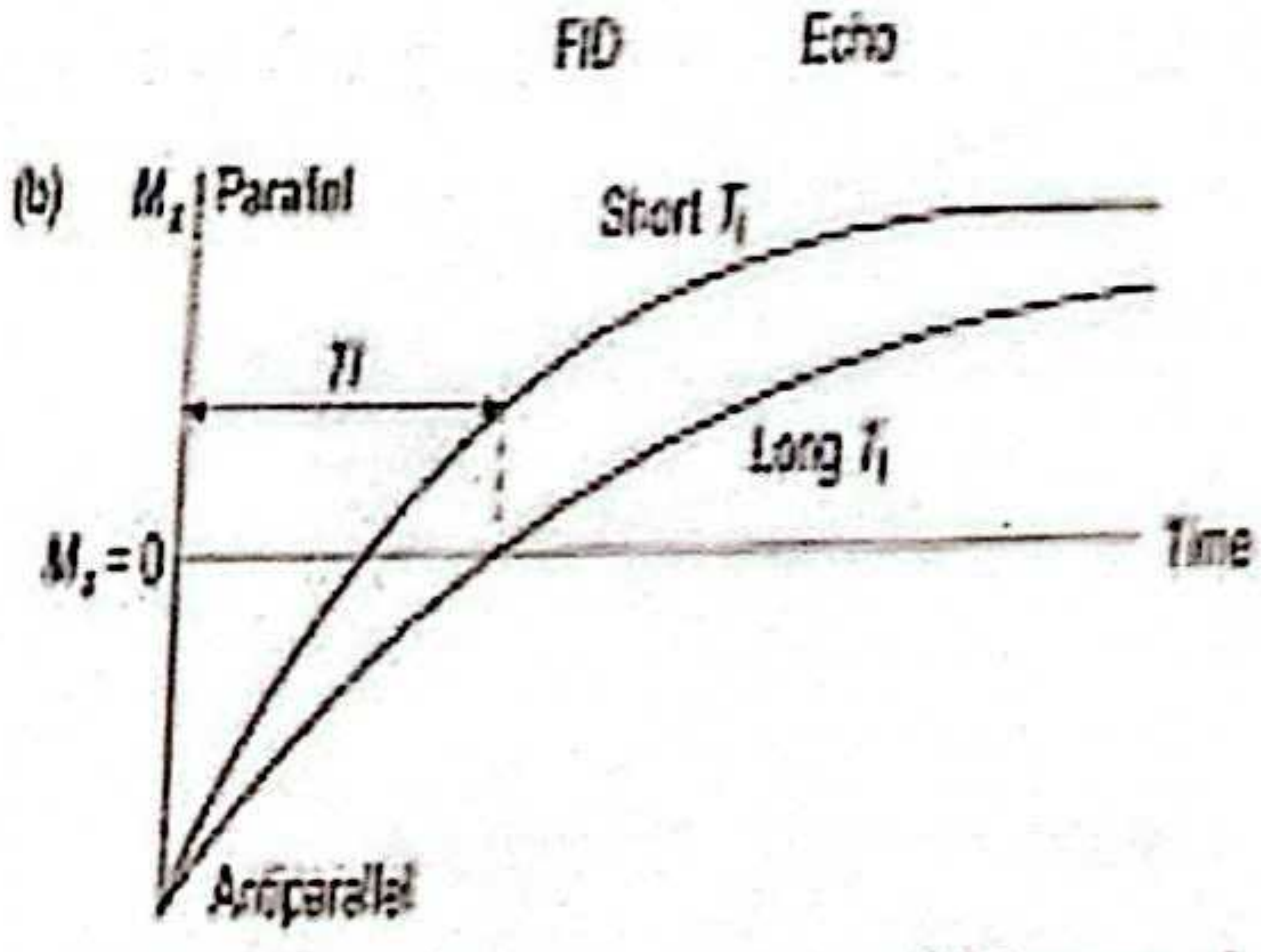


Figure 10.18 (a) Inversion recovery sequence. (b) Recovery of tissue having different T_1 values. FID, free induction decay; *TE*, echo time; *TI*, time to inversion; *TR*, repetition time.

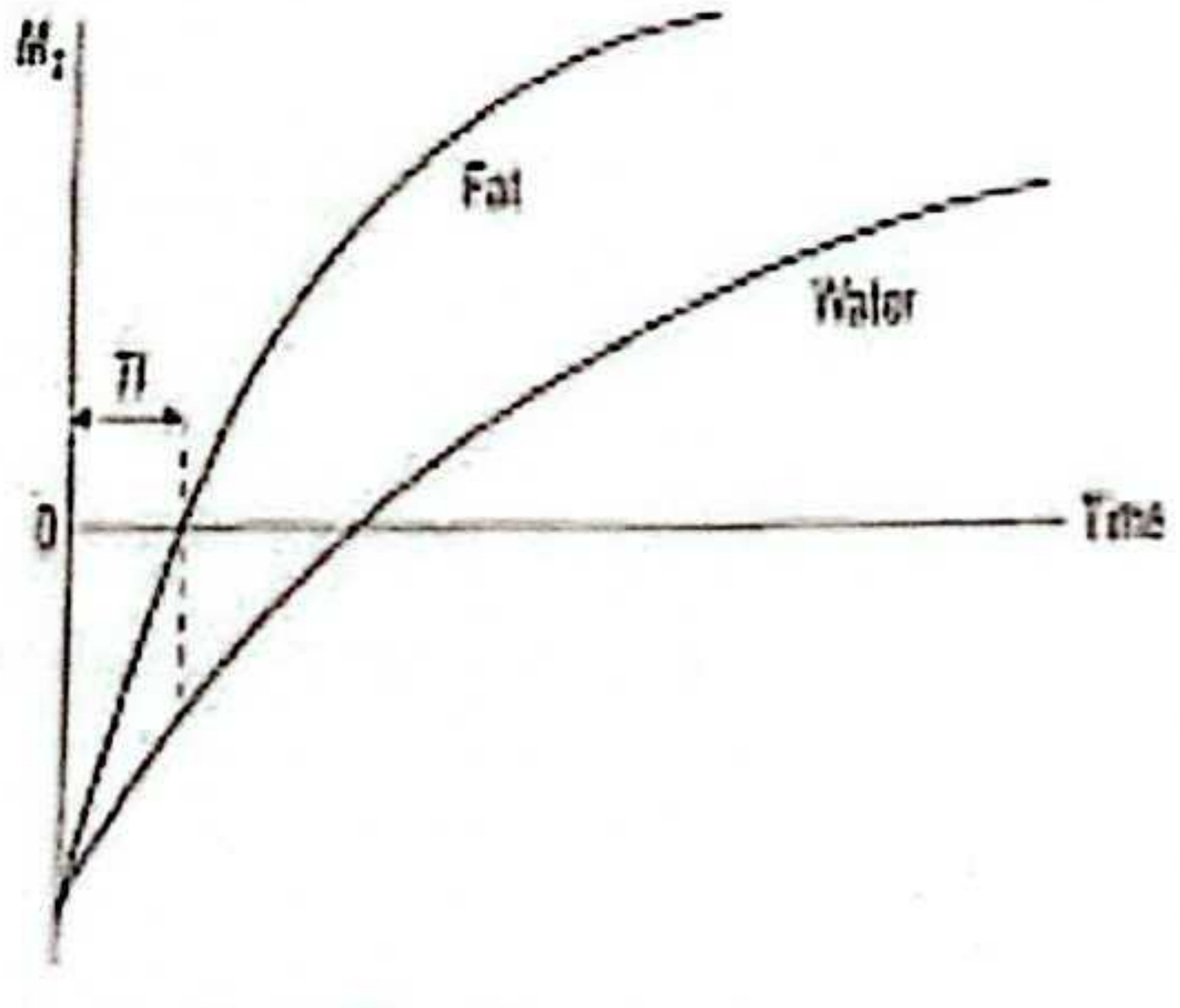
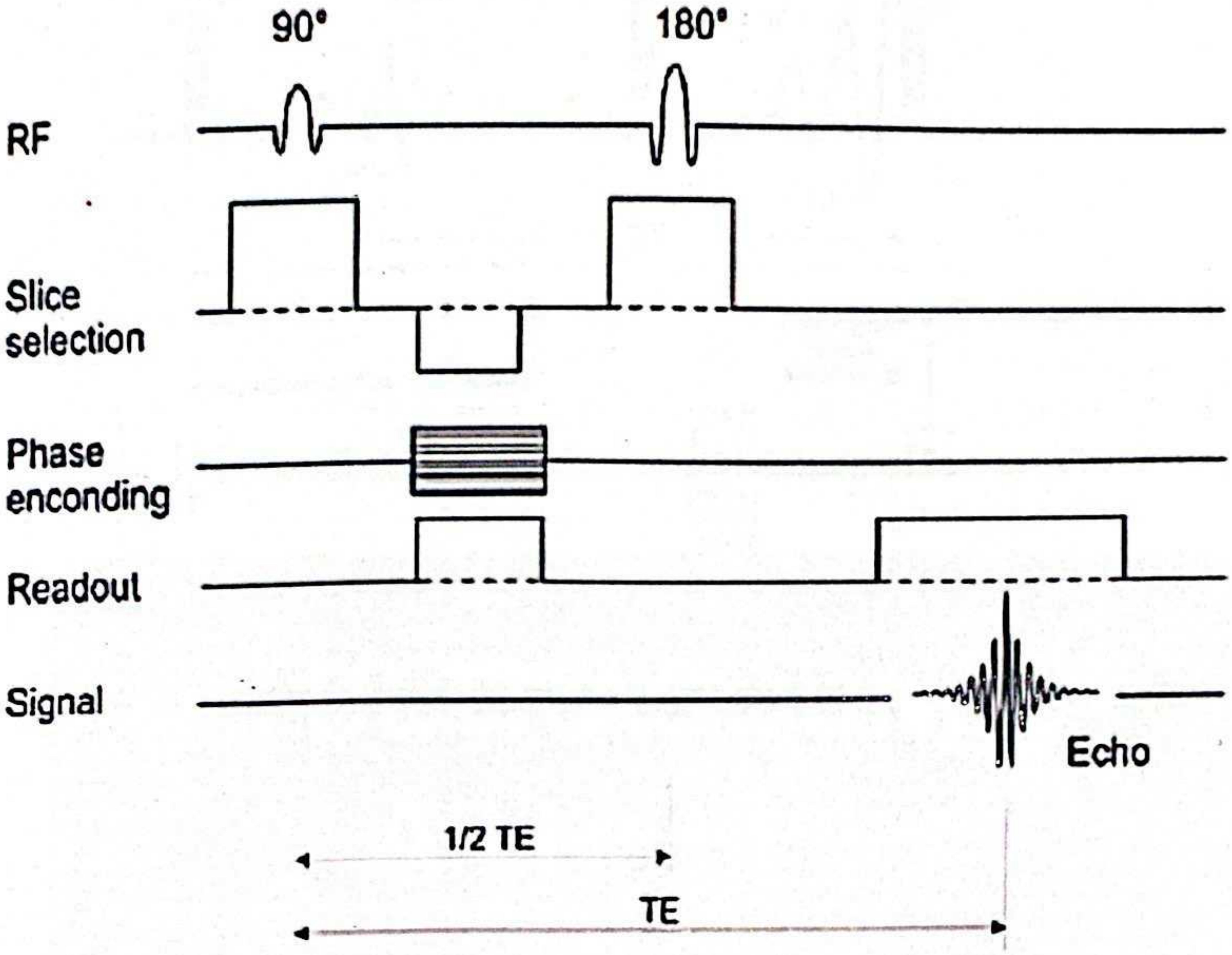


Figure 10.19 Short-*TI* inversion recovery.

Fluid-attenuated inversion recovery = FLAIR

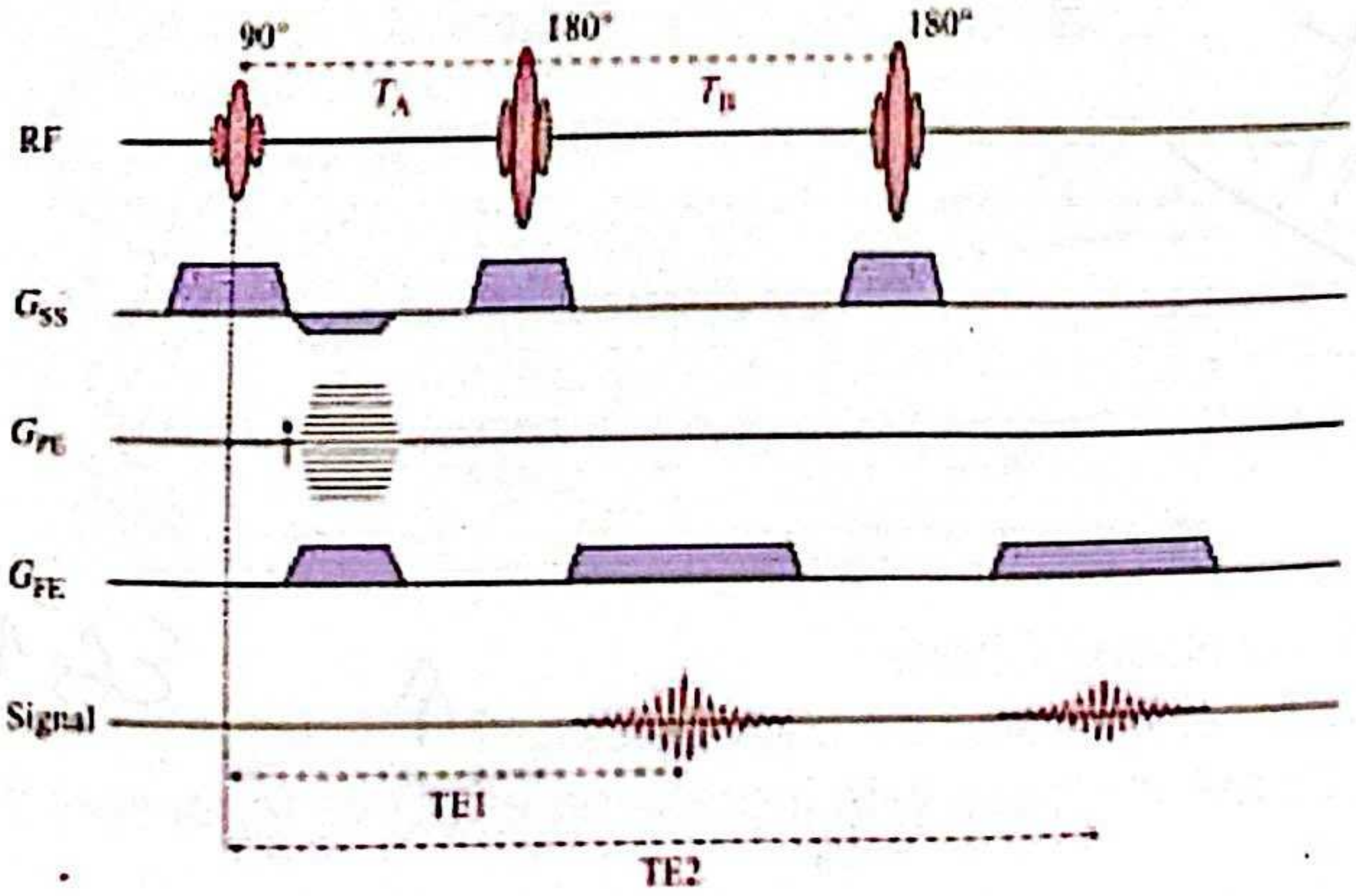
Uses long TI to null the signal from CSF

Q.12)


90°
180°
RF
Slice selection
Phase enconding
Readoul
Signal
Echo
1/2 TE
TE

One Cycle of spin echo sequence

- TE is time to echo---Time between centre of RF pulse to centre of echo
- TR is repetition time---Length of time between two 90° pulses


90°
180°
180°
T_A
T_B
RF
G_{SS}
G_{PE}
G_{FE}
Signal
TE1
TE2

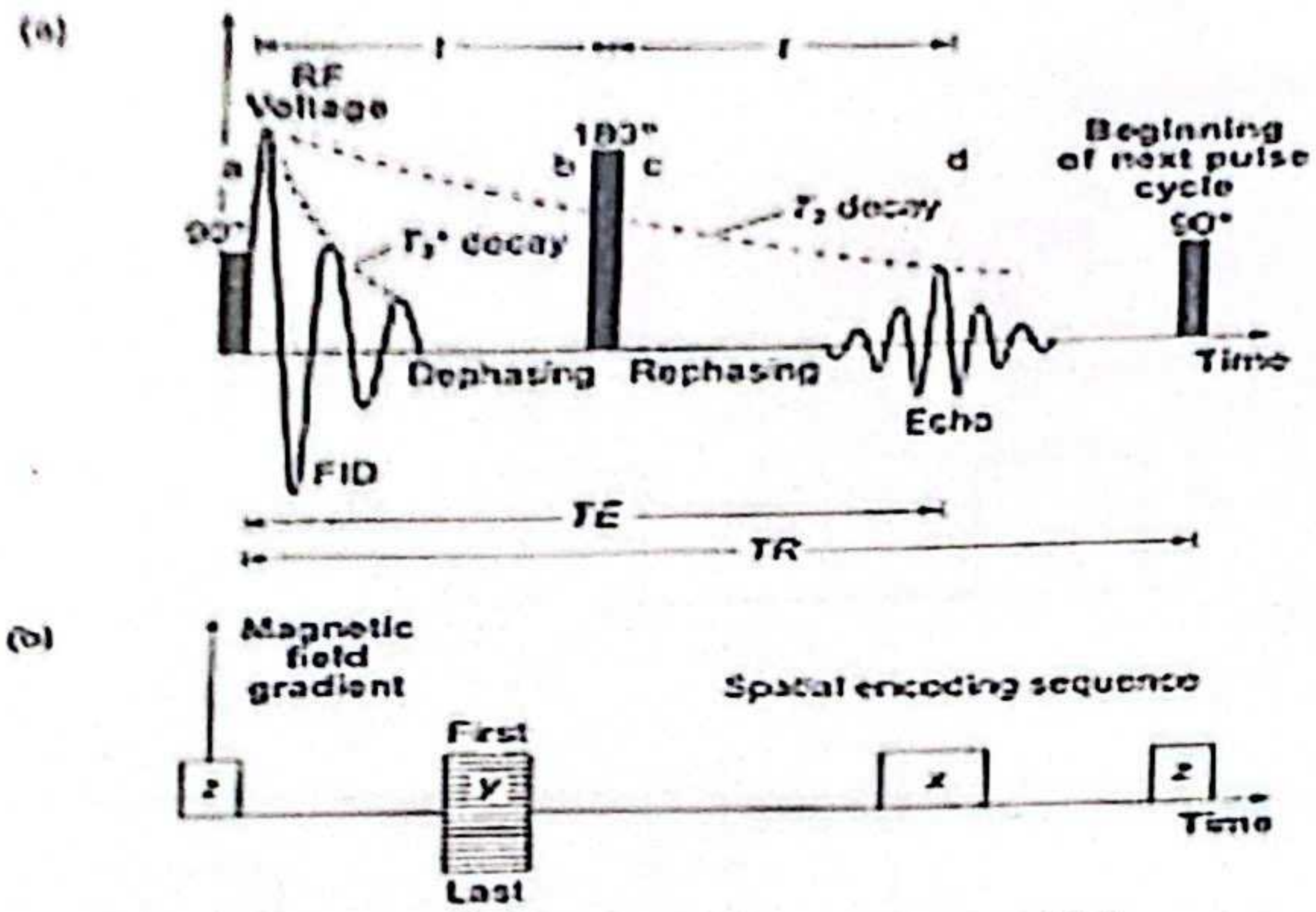

(a)
RF Voltage
τ
τ
a
90°
b
180°
c
d
T_2* decay
T_2 decay
Beginning of next pulse cycle
90°
FID
Dephasing
Rephasing
Echo
Time
TE
TR
(b)
Magnetic field gradient
Spatial encoding sequence
z
First
y
Last
x
z
Time

Figure 10.6 One cycle of the spin-echo sequence of (a) radiofrequency pulses and signal and (b) magnetic field gradient switching. FID, free induction decay; RF, radiofrequency; TE, echo time; TR, repetition time.

- Z-axis applied simultaneously with 90°
- Y-axis applied after 90° before 180°
- X-axis between 180° and 90°

Examples of spin echo:

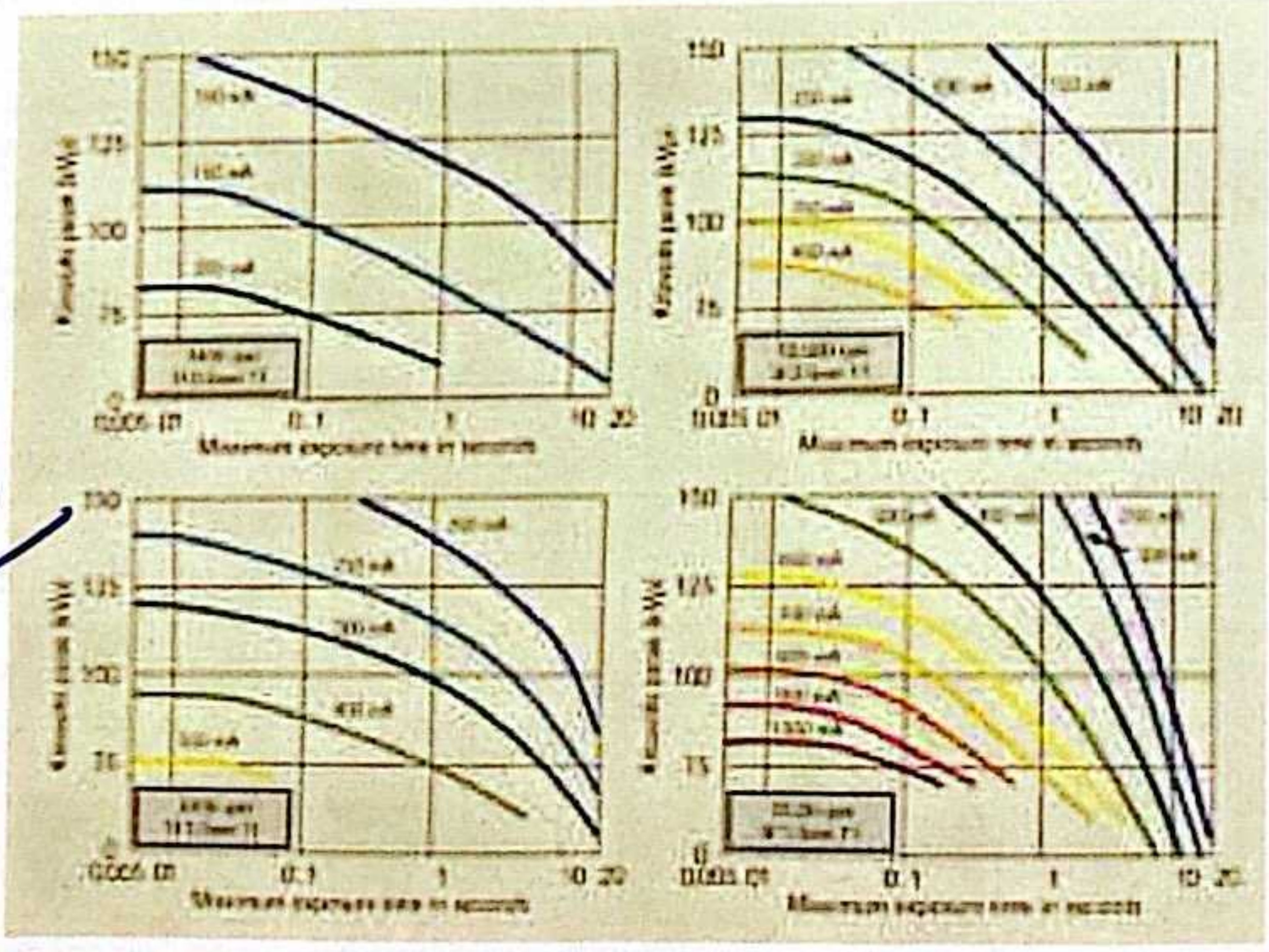
T1, T2, STIR & Inversion recovery

Short T1 for fat supression

Long T1 for fluid suppression FLAIR

quali

↑ mA for smaller Target angles



fs ↑ mA ↑

XRay Tube Rating Charts

↑ Effect of focal spot size on allowable mA? ↑

Efs ↑ ↑

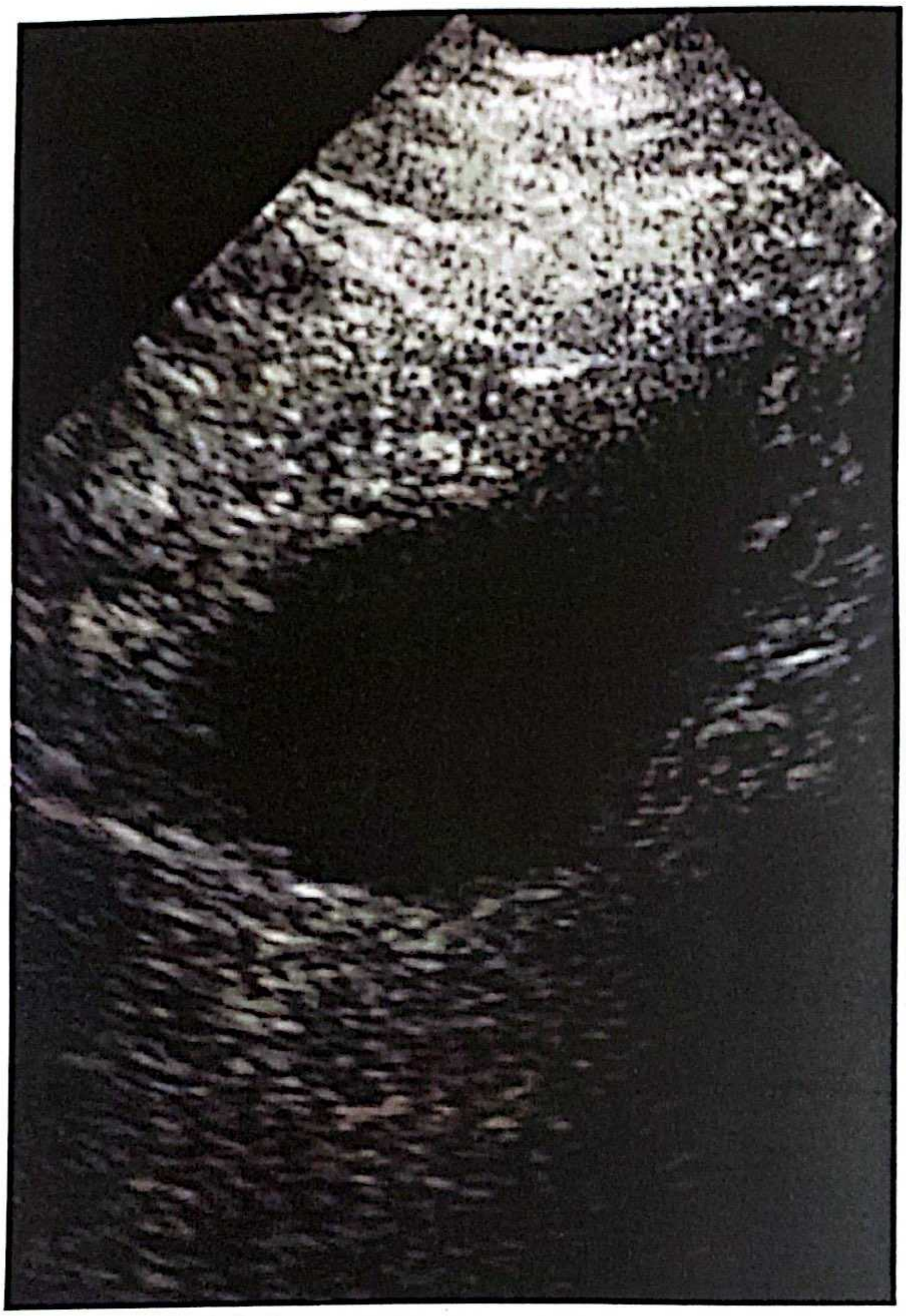
Allowable mA increase with increasing effective focal spot size

Effect of target angle on allowable mA on given focal spot?

↑ mA are greater for smaller target angles

ULTRASOUND ARTIFACTS

Q.1)



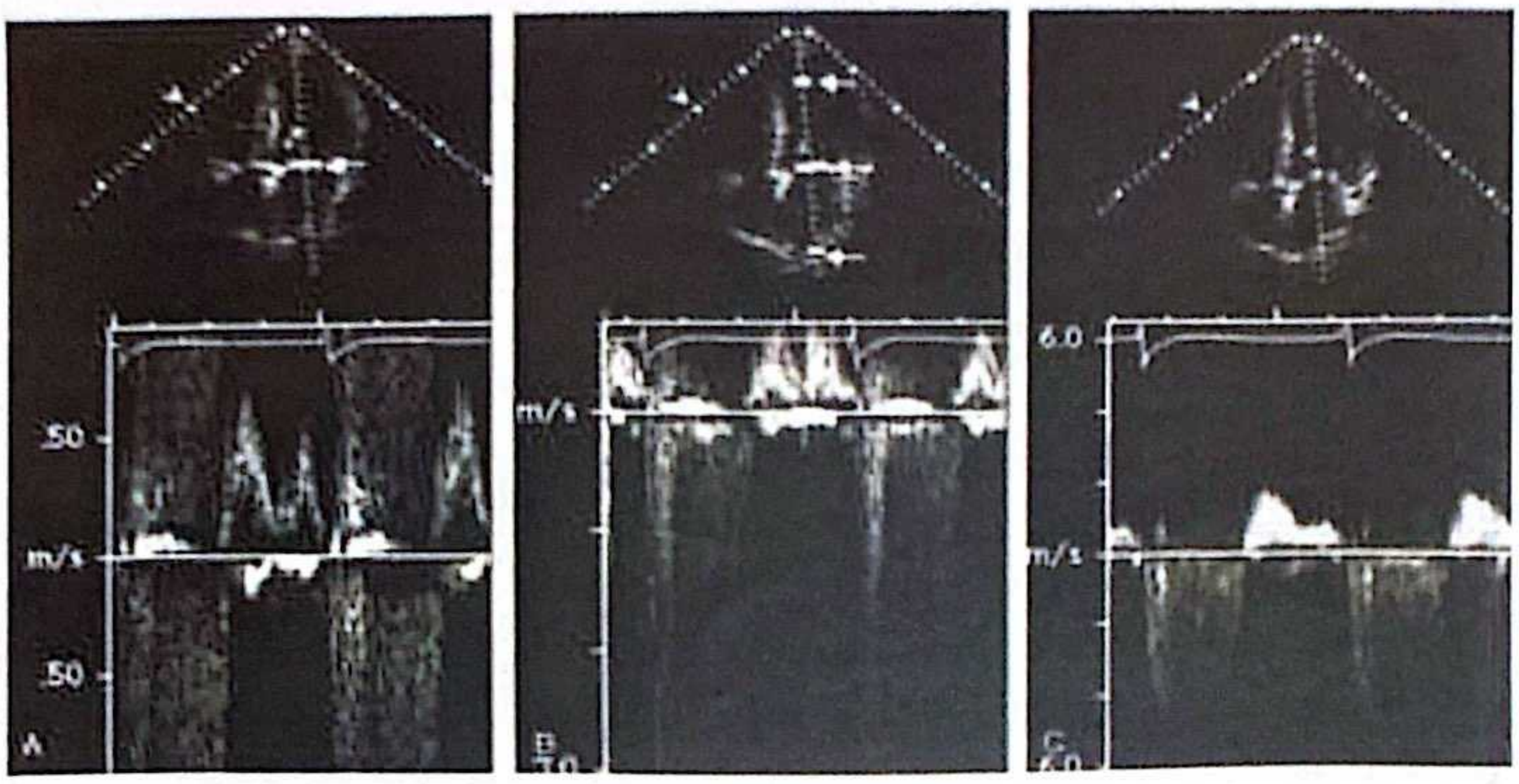
Name: Beam Width
Modality: Ultrasound
Cause:

1. Anechoic structure having peripheral echoes E.g. Urinary Bladder
2. Highly reflective object located within widened beam beyond margin of transducer may generate detectable echoes which are assumed by USG display to originate from wihtin narrow imaging plane

Correction:

1. Adjust focal zone to level of interest
2. Place tranducer at centre of object of interest

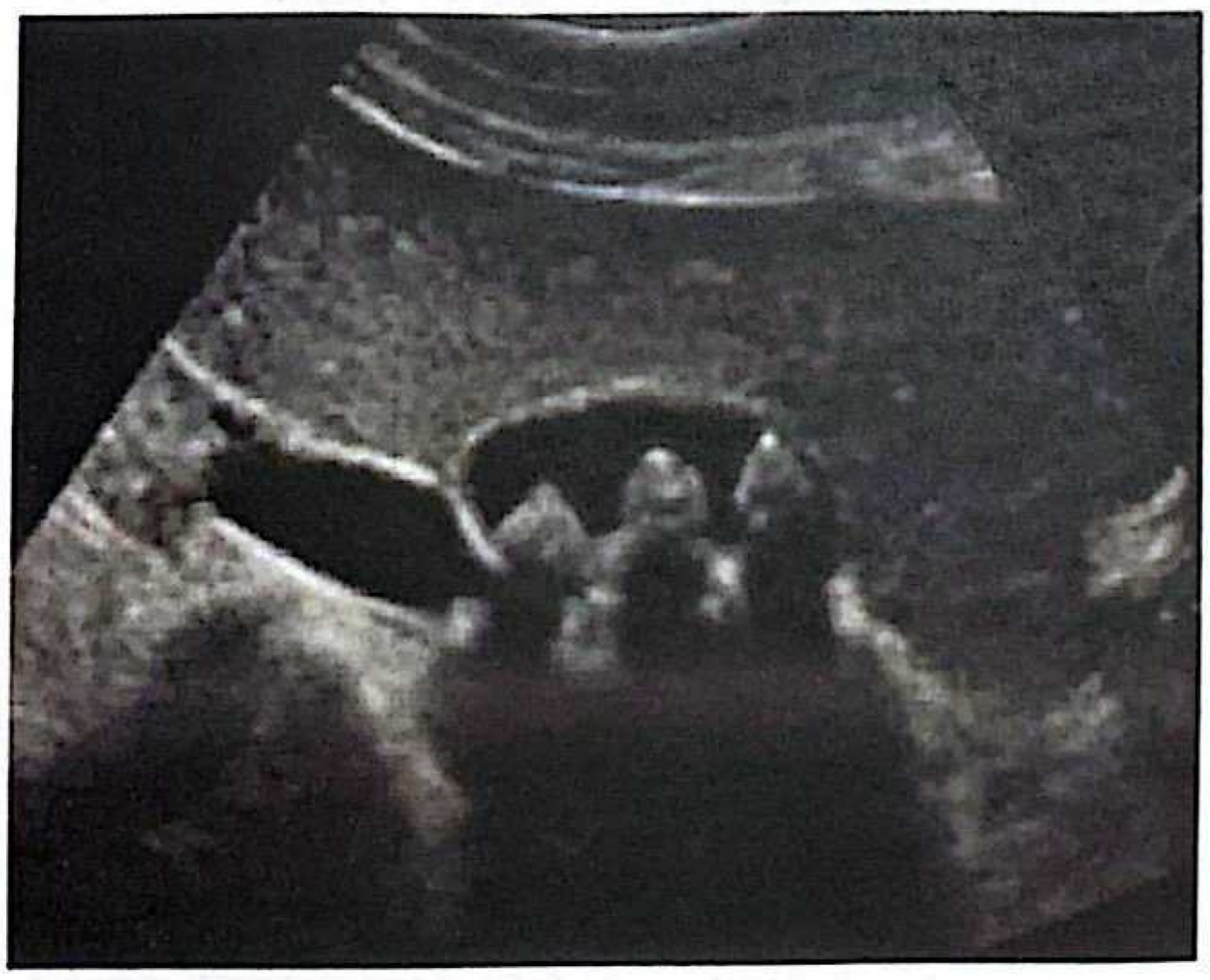
Q.2)



Name: Aliasing With pulsed Doppler
Modality: Colour Doppler Ultrasound
Cause:
If the flow is too fast, it will be shown in the wrong direction and its velocity underestimated. This artefact shows as 'wrap-round' top and bottom in the sonogram
Correction:

1. Reducing the Doppler effect
2. Probe of lower frequency
3. Increasing the angle of isonation
4. Increasing the PRF

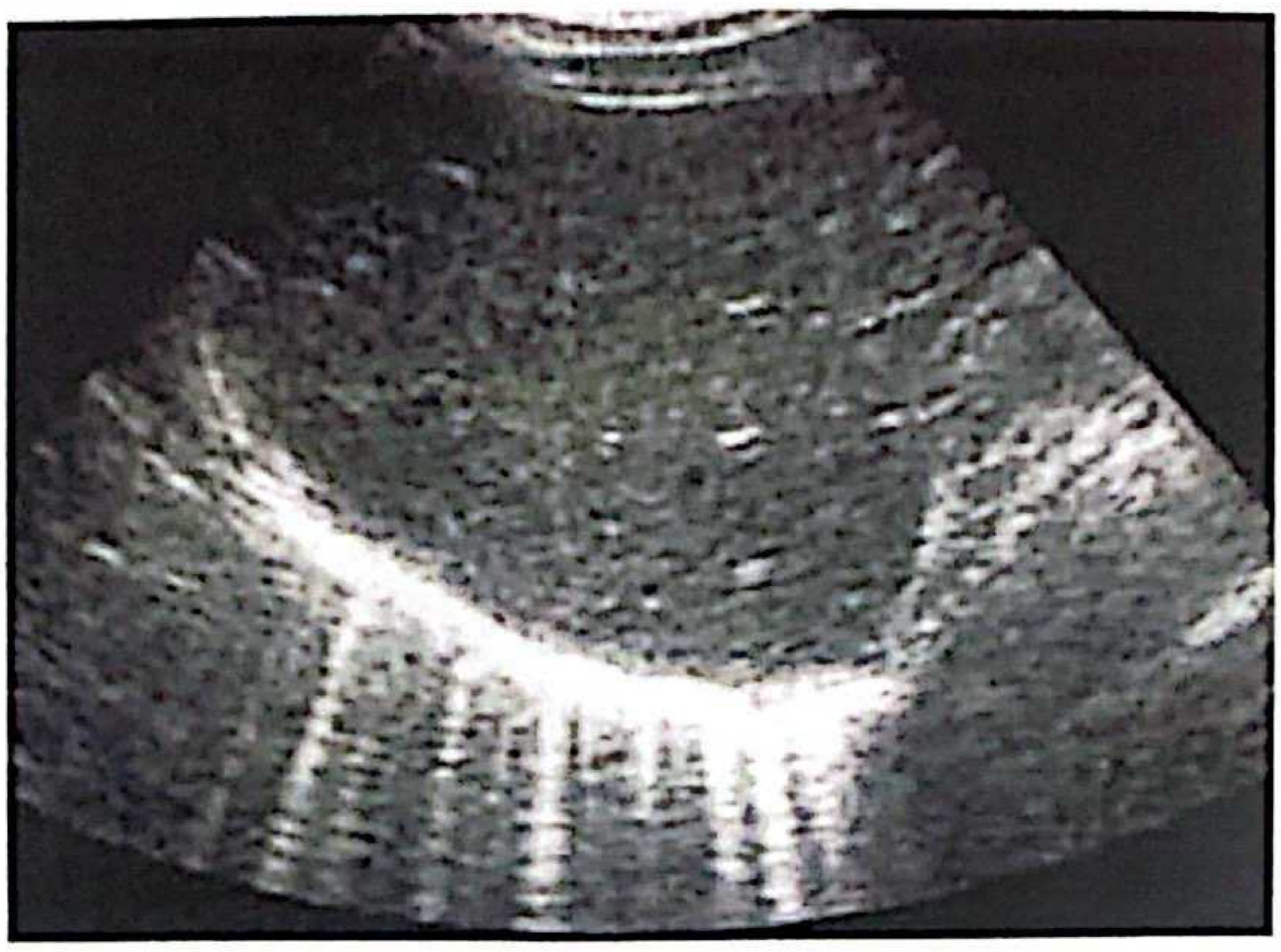
Q.3)



Name: Acoustic shadowing
Modality: Ultrasound
Cause: When USG beam encounters a strongly attenuating structure e.g. calculus, amplitude of the beam distal to structure is diminished & also the echoes.
Correction:

1. Compensation amplification
2. Time gain amplification (TGA)

Q.4)

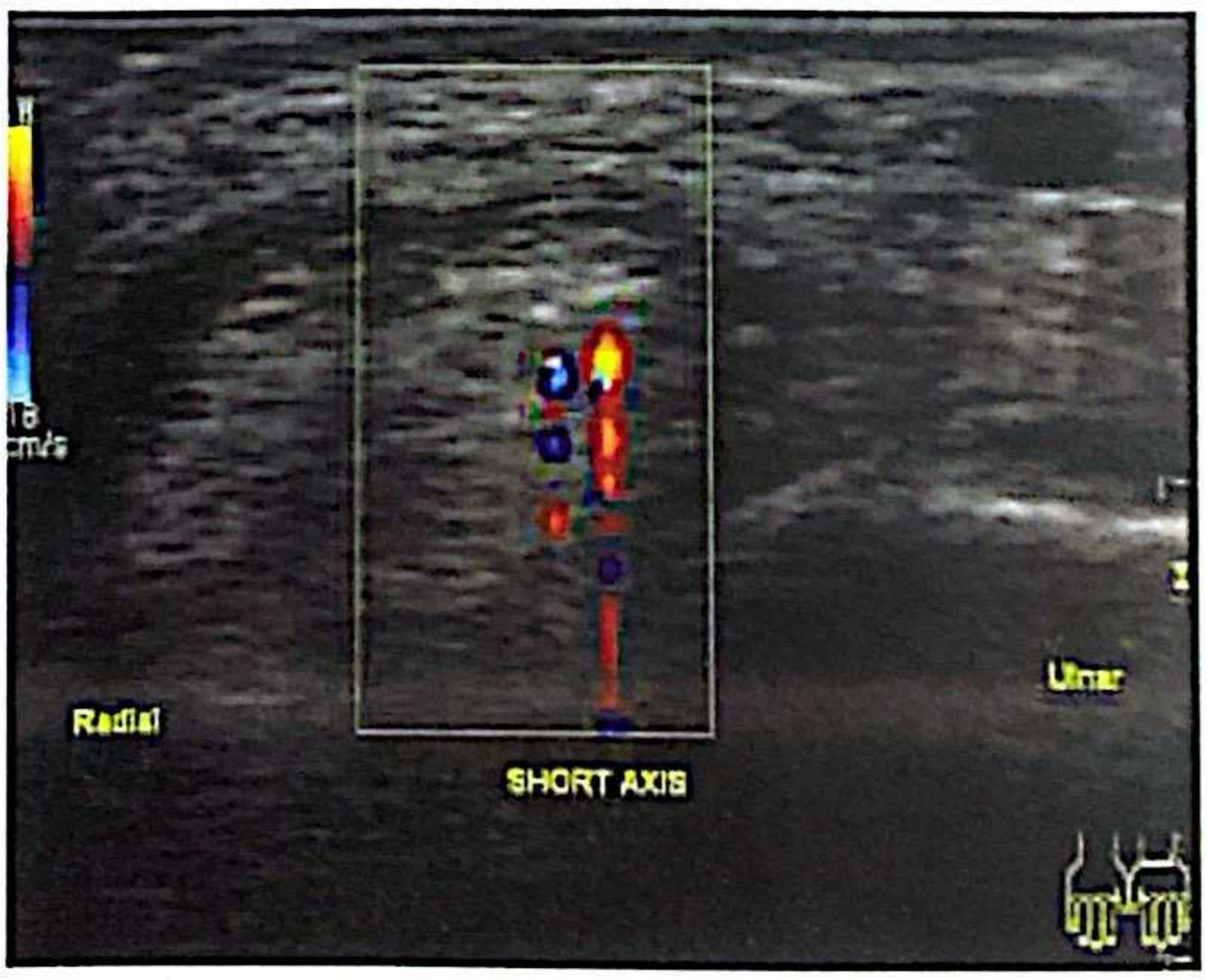


Name: Ring Down Artifacts
Modality: Ultrasound
Cause:

1. Line or series of parallel bands extending posterior to gas collection
2. Transmitted USG energy causes resonant vibrations within fluid trapped between a tetrahedron of air bubbles that creates a continuous sound wave that is transmitted back to transducer

Correction:
Probe Manipulation

Q.5)

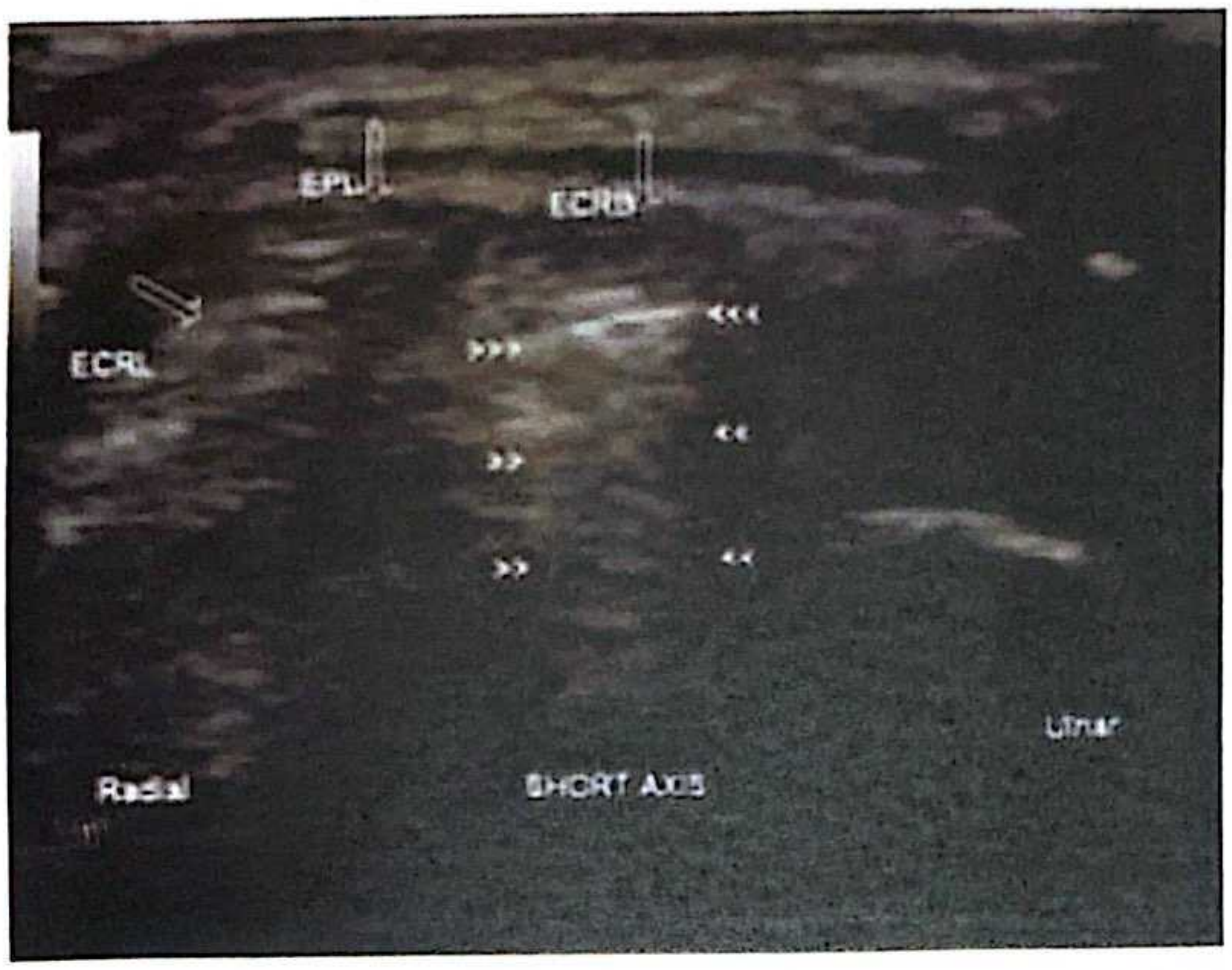


Name: Twinkle Artefact
Modality: Doppler Ultrasound
Cause:

1. Intrinsic machine noise
2. When reflecting surface is rough

Correction:
Re-evaluate machine settings

Q.6)

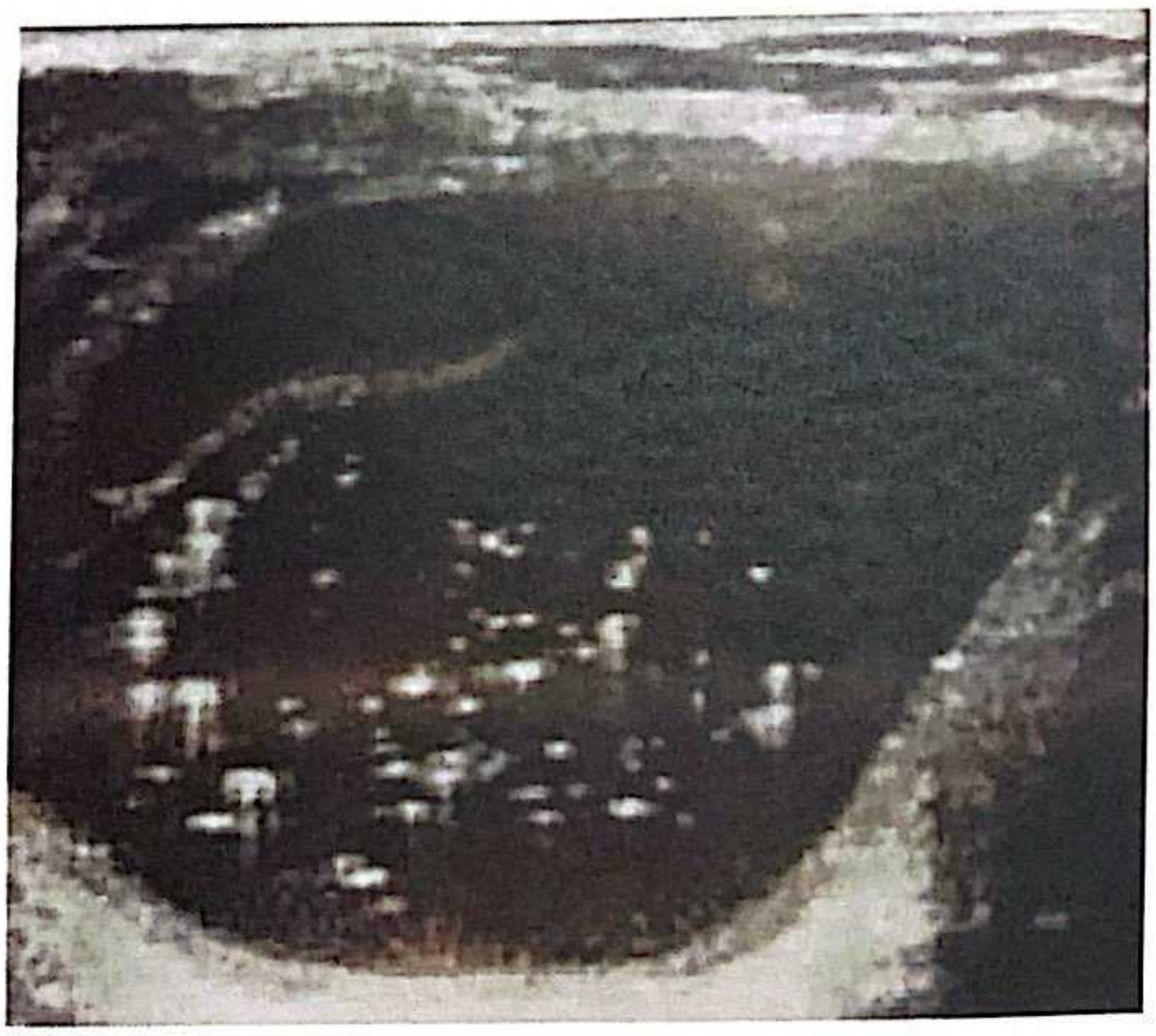


Name: Reverberation Artefact
Modality: Ultrasound
Cause:

1. In presence of 2 highly reflective surfaces, echoes generated from primary USG beam may be repeatedly reflected back & forth before returning to transducer for detection.
2. Multiple echoes are recorded & displayed

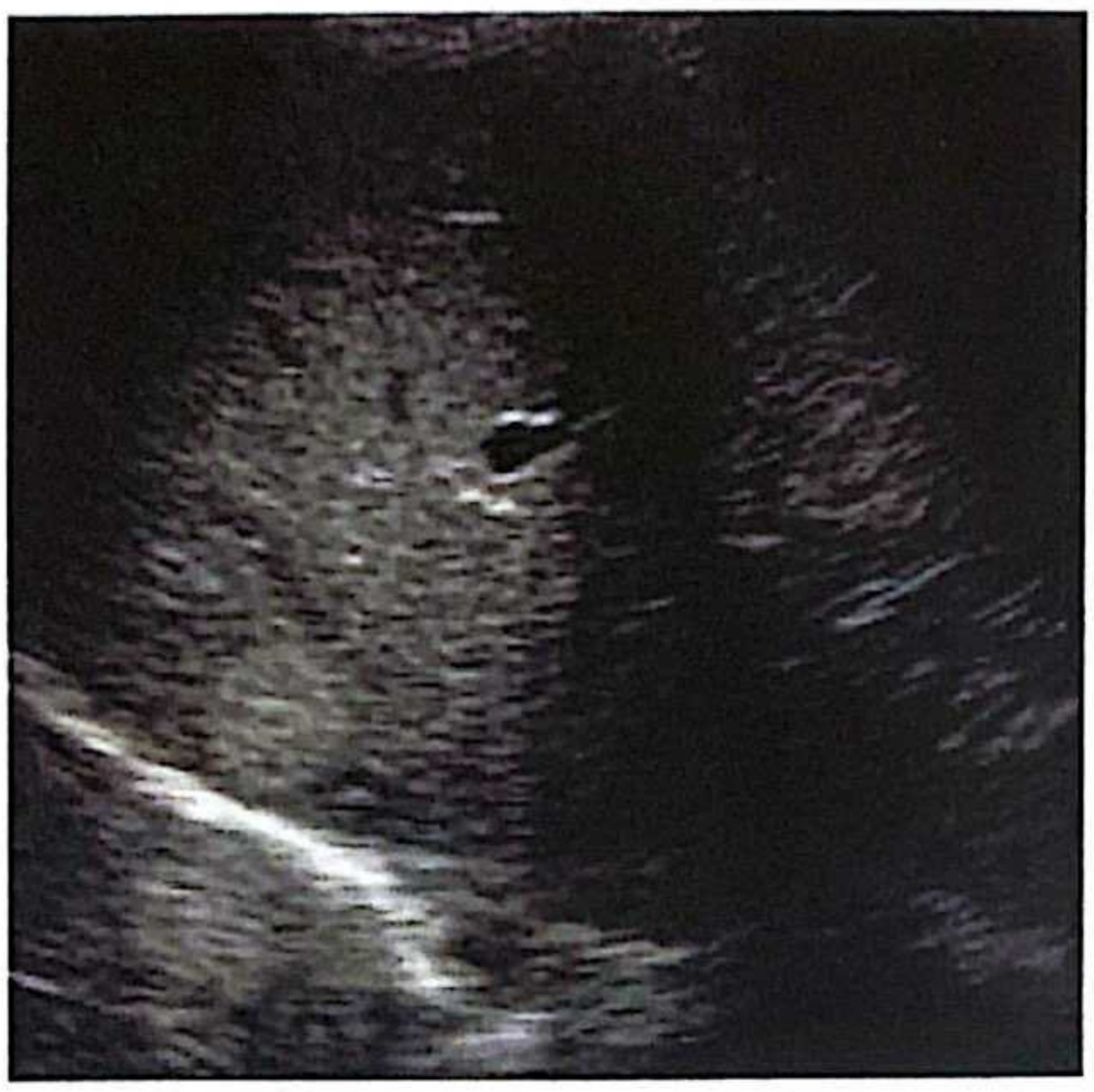
Correction:
Probe Manipulation

Q.7)



Name: Comet Tail
Modality: Ultrasound
Cause:
The 2 reflective surfaces are closely spaced so that on display individual signals are not perceived & later echoes have decreased amplitude due to attenuation which is displayed as decreased width

Q.8)

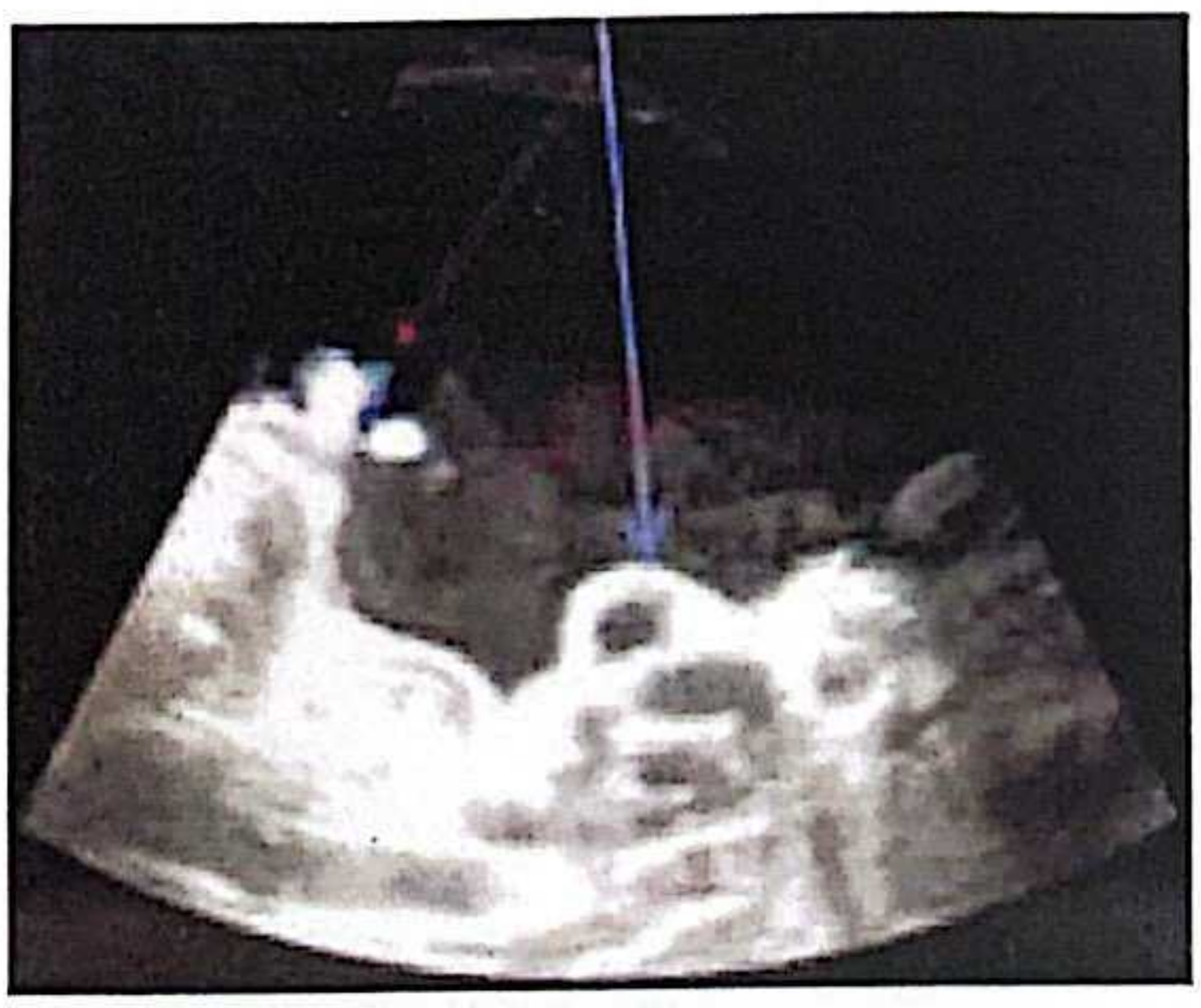


Name: Mirror Imaging Artefact
Modality: Ultrasound
Cause:

1. Duplicated structure equidistant from but deep to strongly reflective interface e.g., pleural air interface near diaphragm
2. Primary beam encounters a highly reflective interface. Reflected echoes encounter back side of structure & reflected towards reflective interface before reflecting to transducer for detection

Correction:
Probe Manipulation

Q.9)

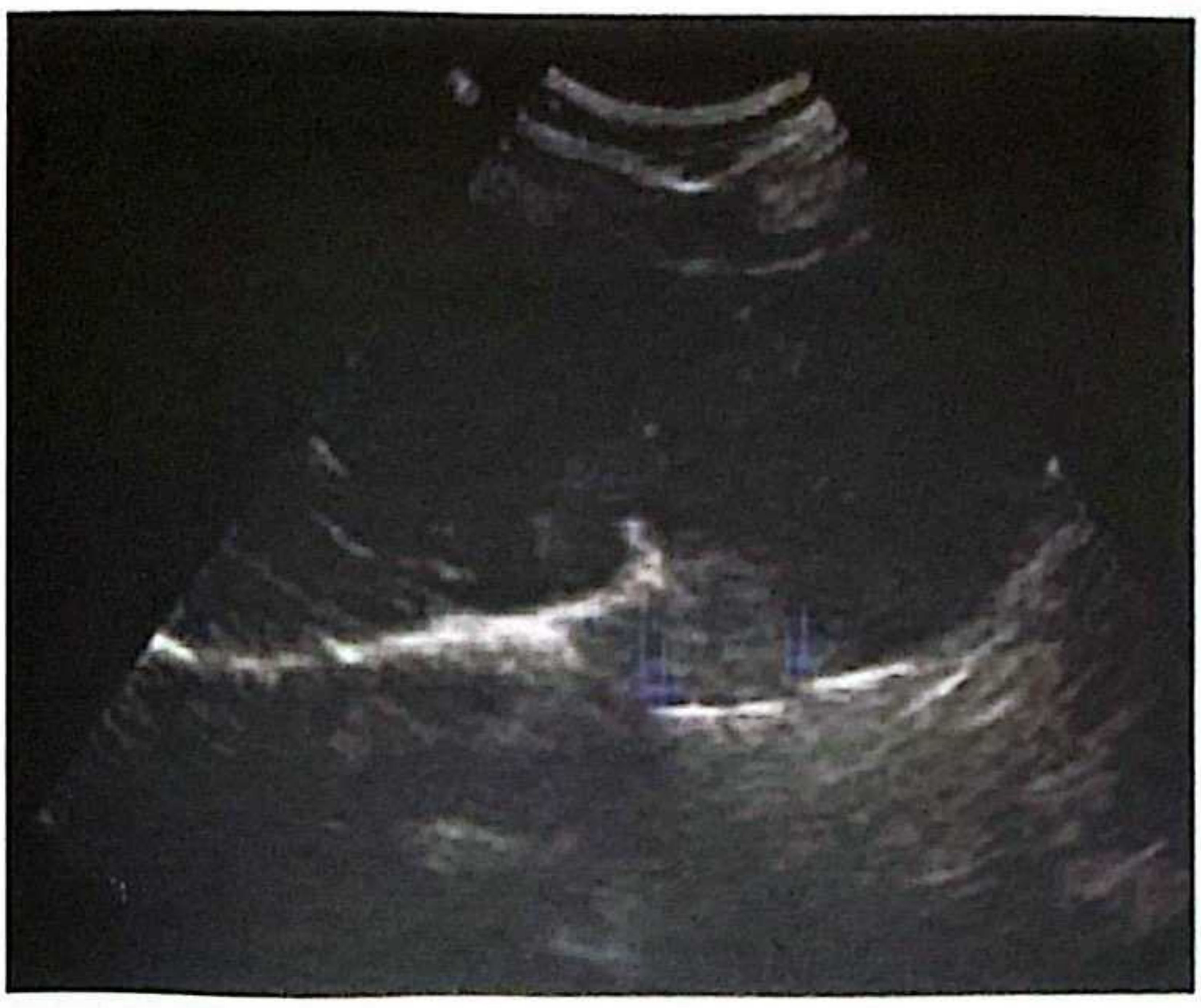


Name: Side lobe Artefact
Modality: Ultrasound
Cause:

1. Anechoic structure having extraneous/peripheral echoes e.g. UB
2. Multiple beams of low intensity projecting radially from main beam axis.
3. Strong reflections in their path may create detectable echoes

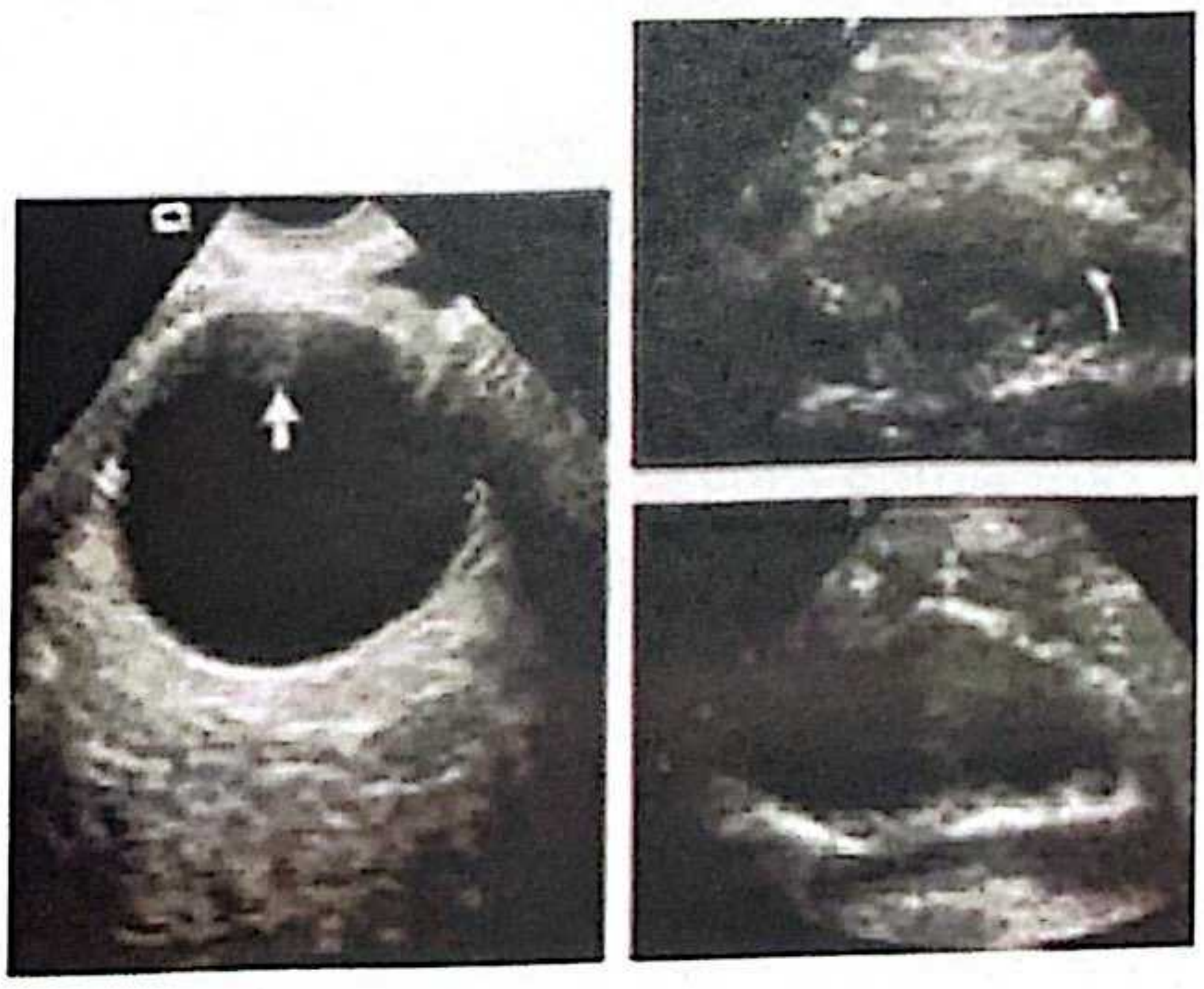
Correction:
Probe Manipulation
adaptive post-processing

Q.10)



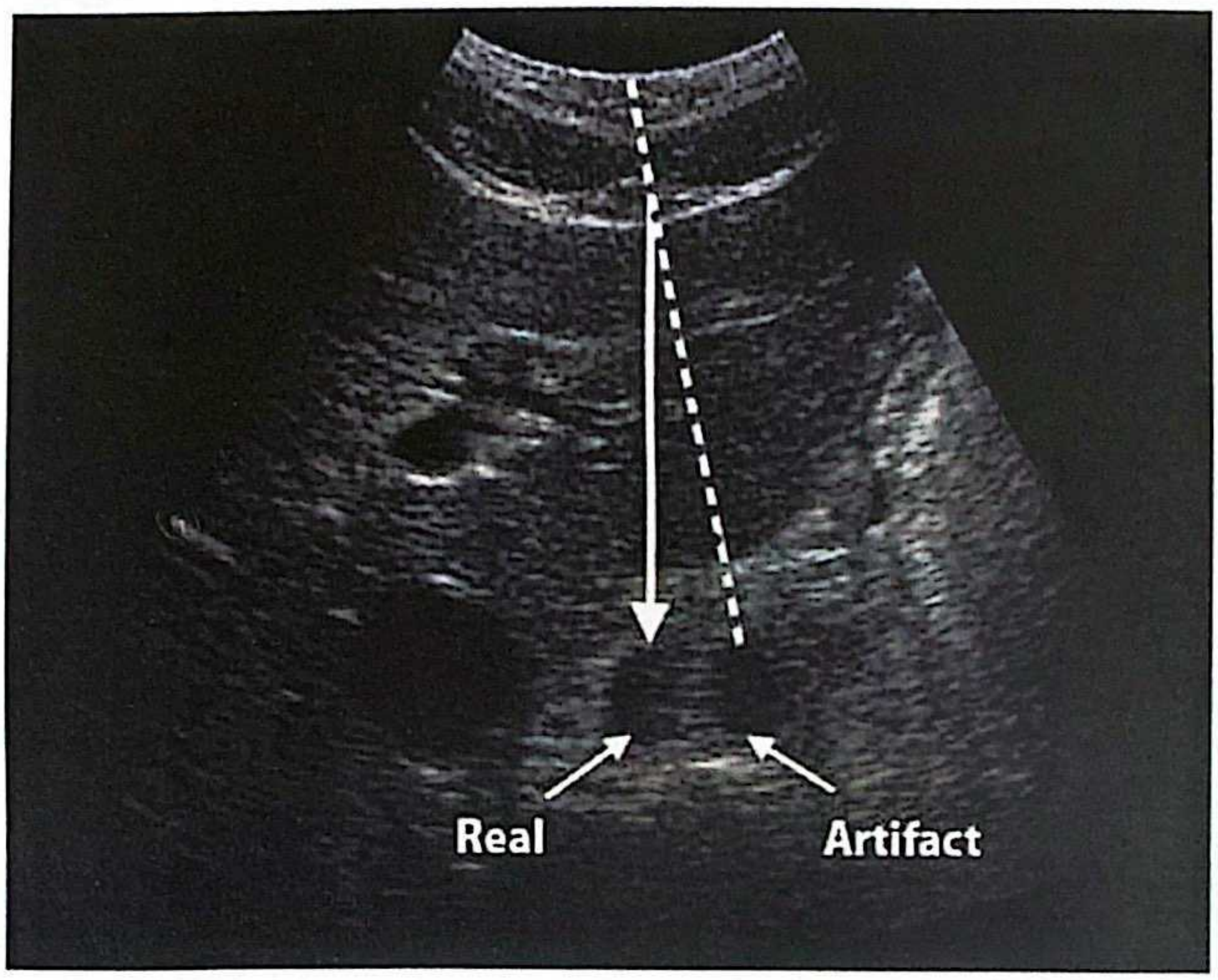
Name: Speed Displacement
Modality: Ultrasound
Cause: Echoes displaced deeper on image than reality e.g., focal fat Sound has different velocities in different materials while image processor assumes length of time for a single round trip of echo to be related to distance tavelled by echo only. So if sound speed is markedly slower somewhere then the echo returning would be falsely considered coming from deeper than actual area
Correction:
adaptive post-processing

Q.11)



Name: Speckle Artefact
Modality: Ultrasound
Cause:
Textured appearance due to interference between waves scattered from many small structures too small & close to be resolved within tissue
Correction:
Reduced using techniques that reduce noise (i.e, higher frequency transducer, real-time compounding, adaptive post-processing, and harmonic imaging)

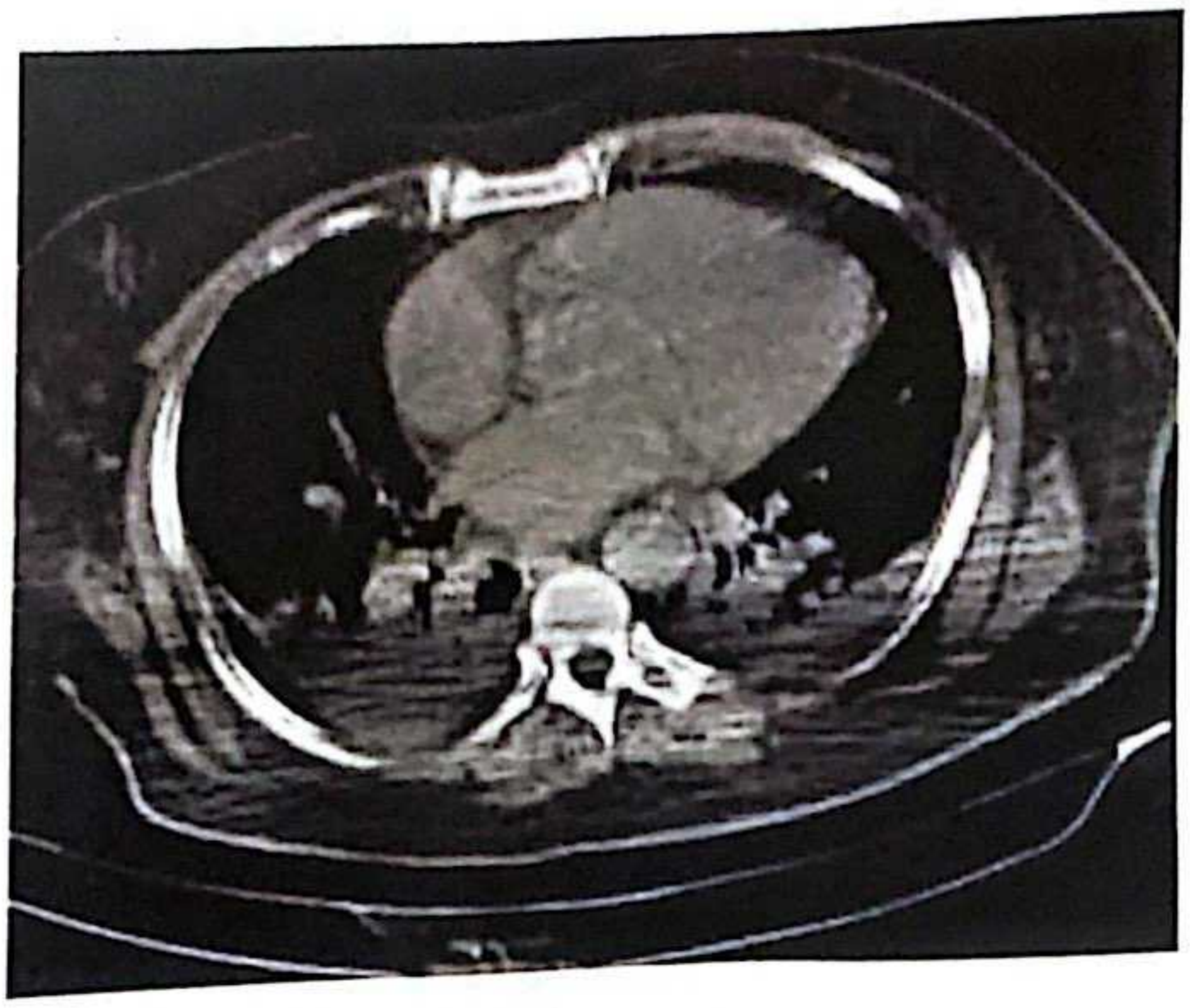
Q.12)



Name: Refraction
Modality: Ultrasound
Cause:
Structure wider than actual or apparent duplicaiton e.g., pelvic structures deep to junction of rectus muscle & midline fat
Change in velocity of sound in travelling through tissues with different density & elastic properties makes non-perpendicular incident USG beam change direction (change in direction depends on angle of incident beam and difference of velocities b/w the two surfaces).
The USG display assumes straight path & misplaces returning echoes to side of true location
Correction:
Probe Manipulation
adaptive post-processing

CT ARTIFACTS

Q.1)

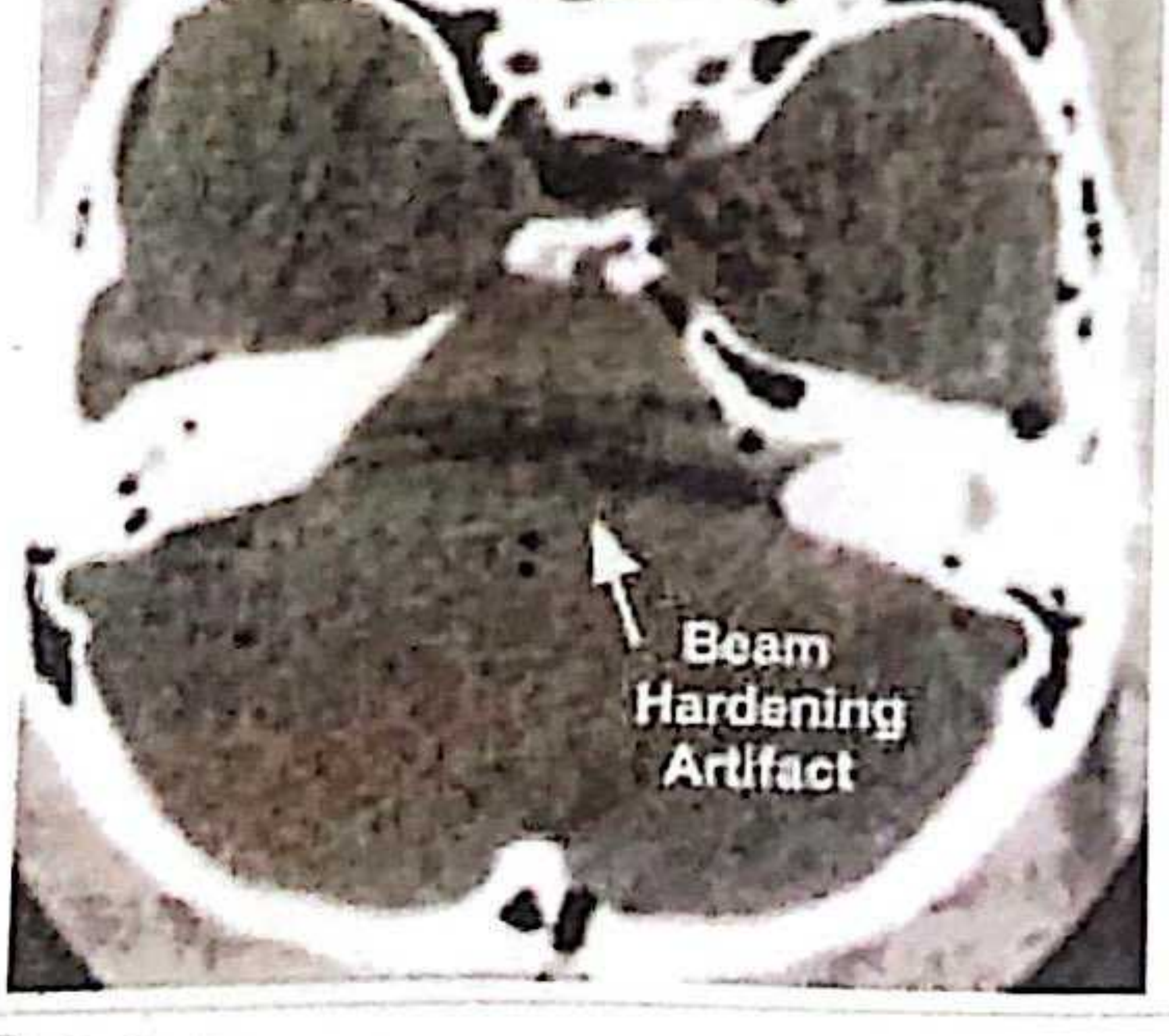


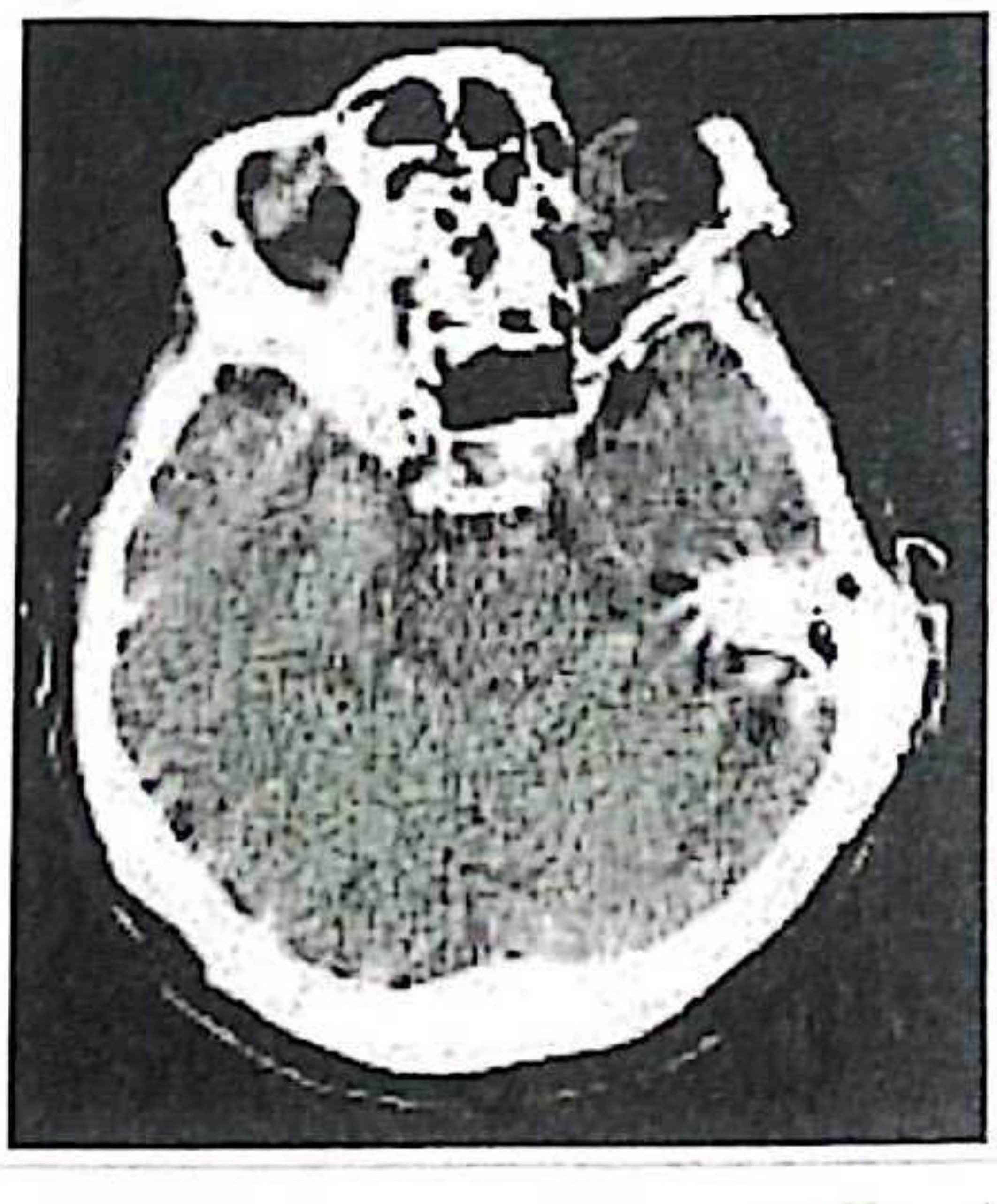
Name: Beam hardening
Types:
Cupping- Cup shaped (cylindrical object)
Streaks and dark bands-Alternate dark bands and streaks b/w two dense objects
Modality: CT
Cause: As the beam of CT X-rays passes through an object it becomes hard as the low energy photons are absorbed more than higher energy photons, hence the attenuation coefficient & CT number decrease along the beam path
Correction:
By manufacturer:

1. Filtration e.g., bowtie filter use
2. Software correction
3. Calibration correction

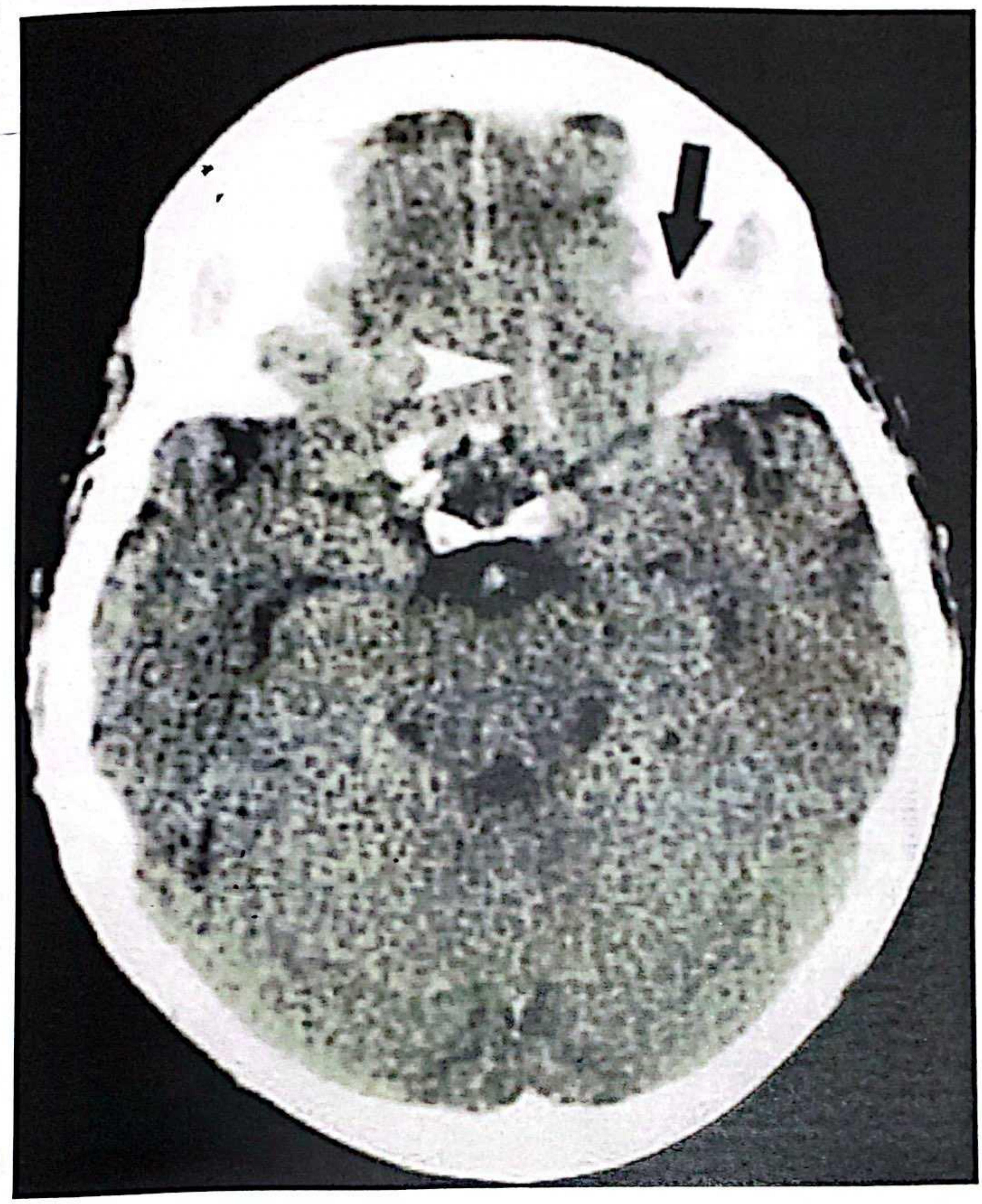
By operator:

1. Patient positioning
2. Gantry tilting



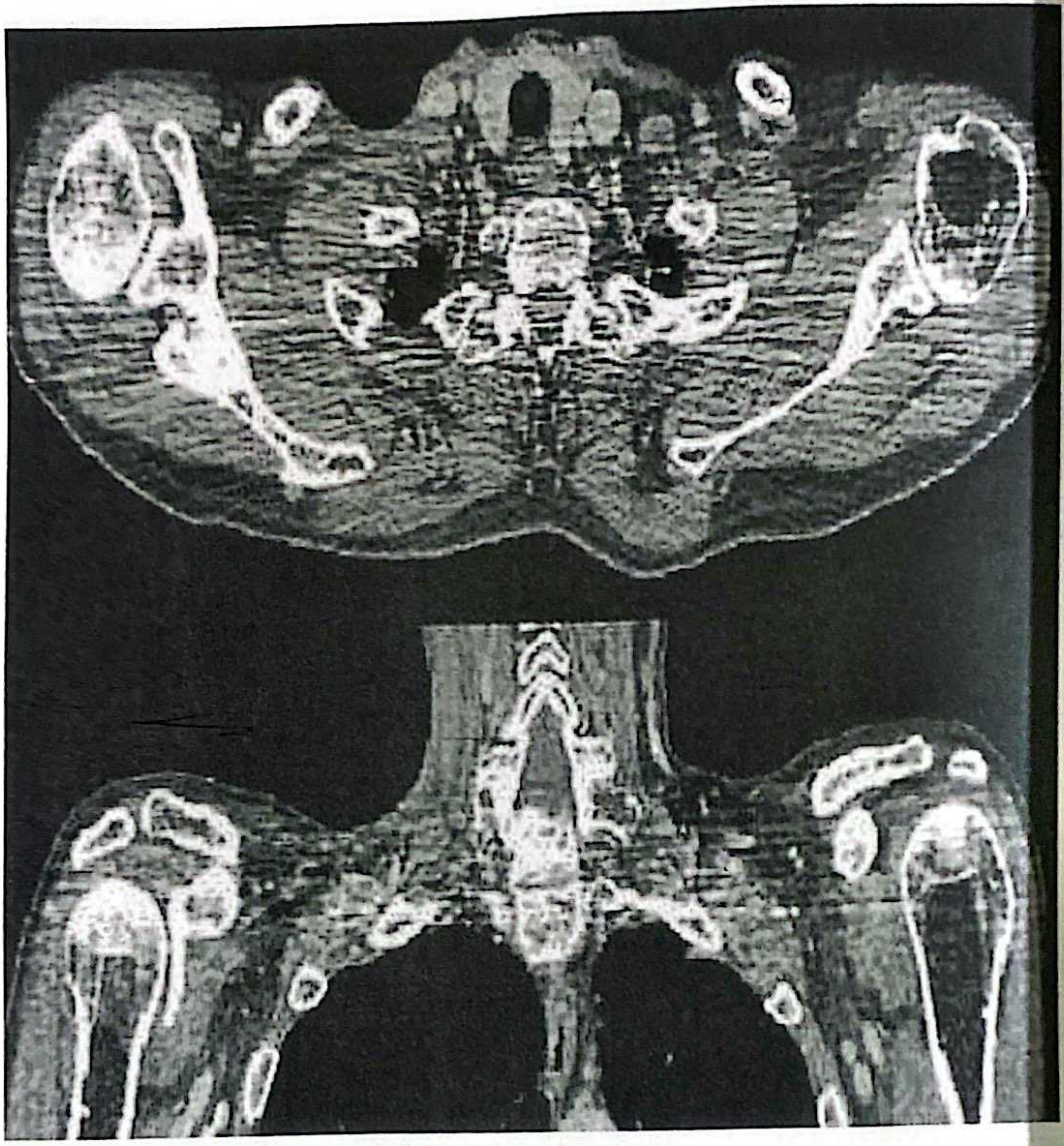


Q.2)



Name: Partial volume
Modality: CT
Cause: Shading a dense object lying off centre protrudes part way into width of beam
Correction:
Thin acquisition slice width (negative impact on noise-it will increase)

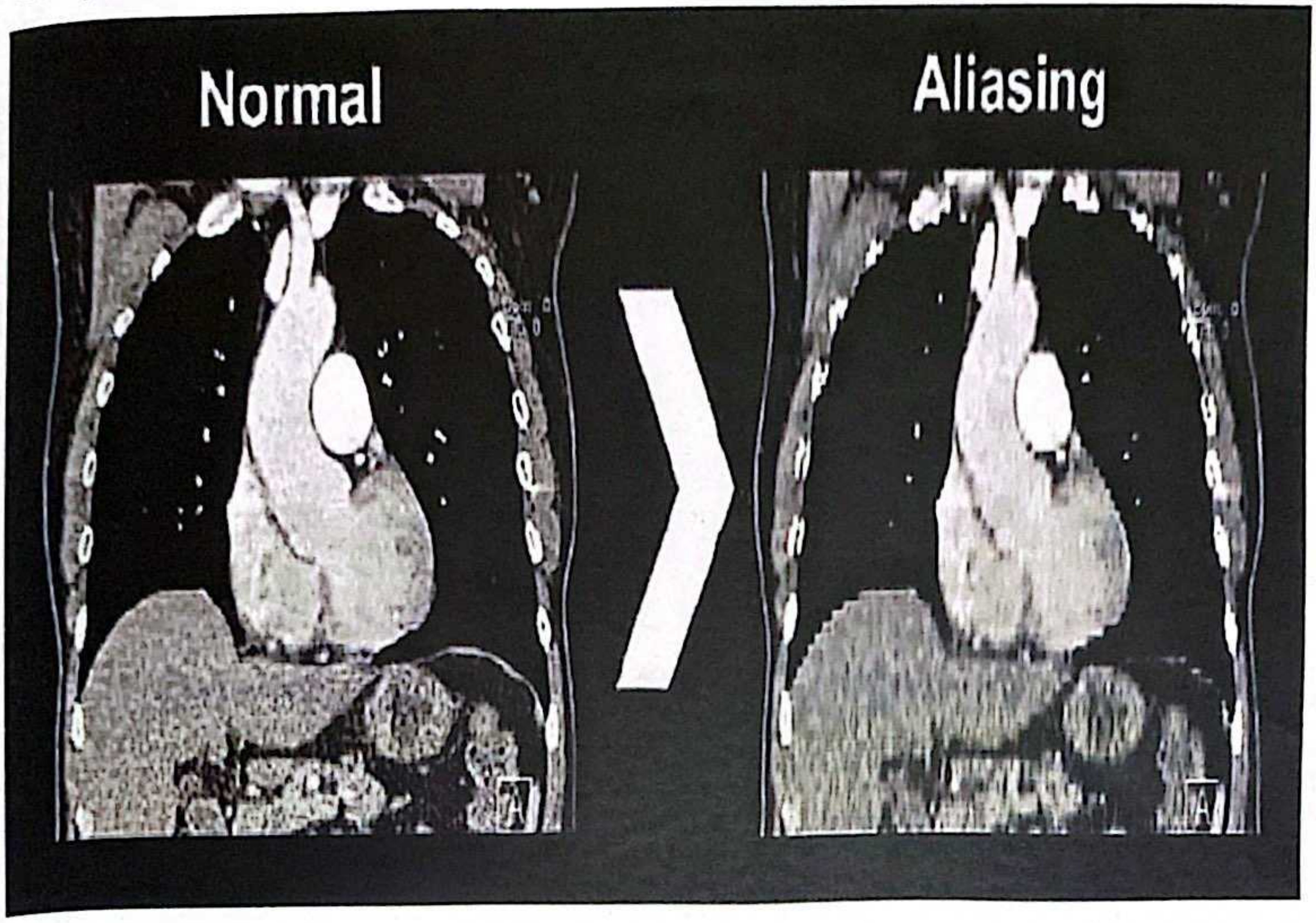
Q.3)



Name: Photon starvation
Modality: CT
Cause: In highly attenuating areas, insufficient photons reach detectors resulting in noisy projection. This is magnified by reconstruction process resulting in artefact
Correction:

1. Automatic tube current modulation (milliamperage modulation-more rays in thicker part and less in thinner)
2. Adaptive filtration (software correction)

Q.4)



Name: Under sampling (Aliasing)

Types:

1.View aliasing (fine stripes appear raditing from edge of, but distally from dense structure)

2.Ray aliasing (close to structure)

Modality: CT

Cause:

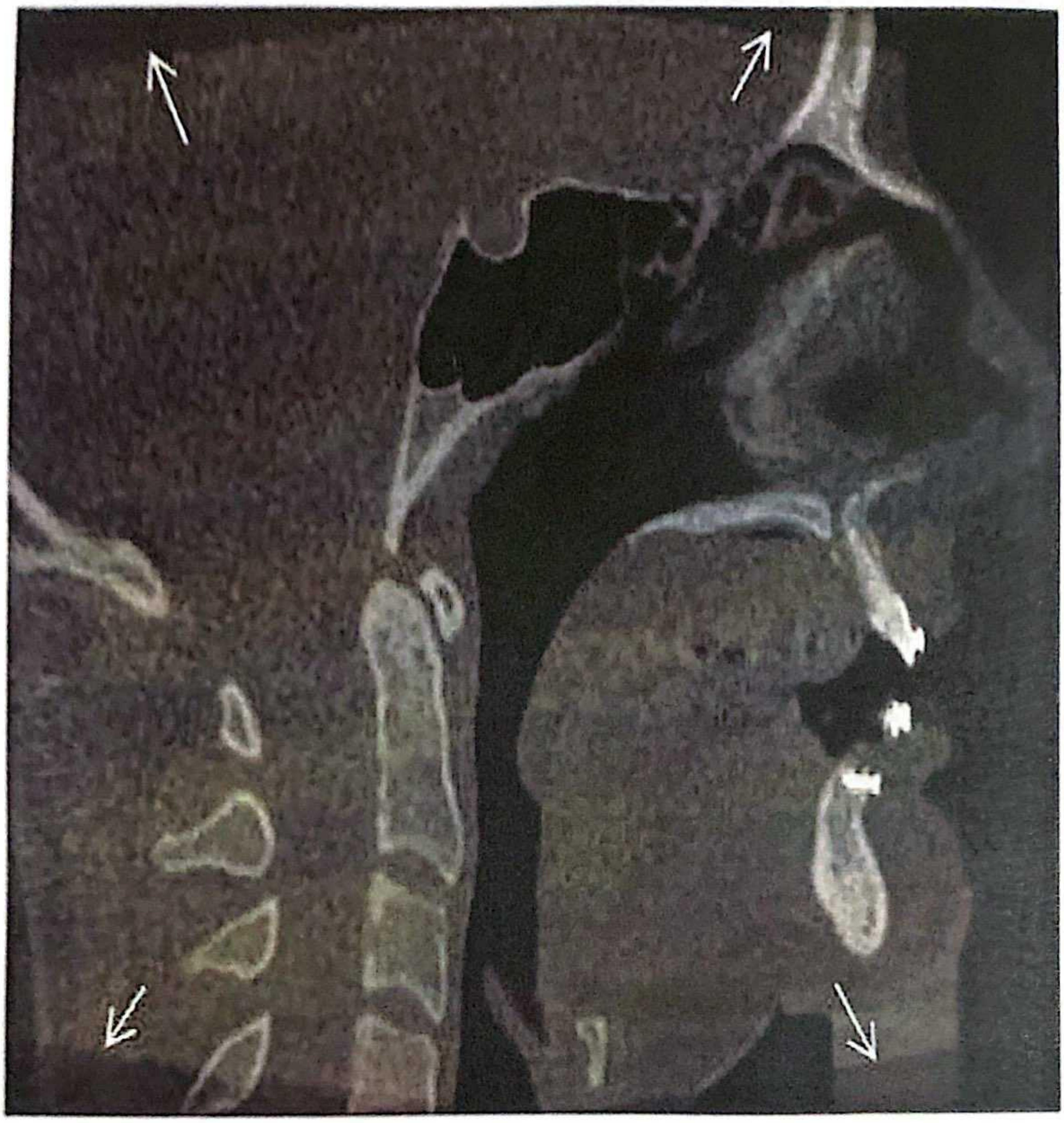
1. Very large interval b/w projections results in misregistration by computer of information relating to sharp & small objects (View aliasing)
2. Under sampling within a projection (Ray aliasing)

Correction:

Increasing number of samples by:

1. Acquiring largest number of projections per rotation (View aliasing)
2. High resolution technique (Ray aliasing)

Q.5)

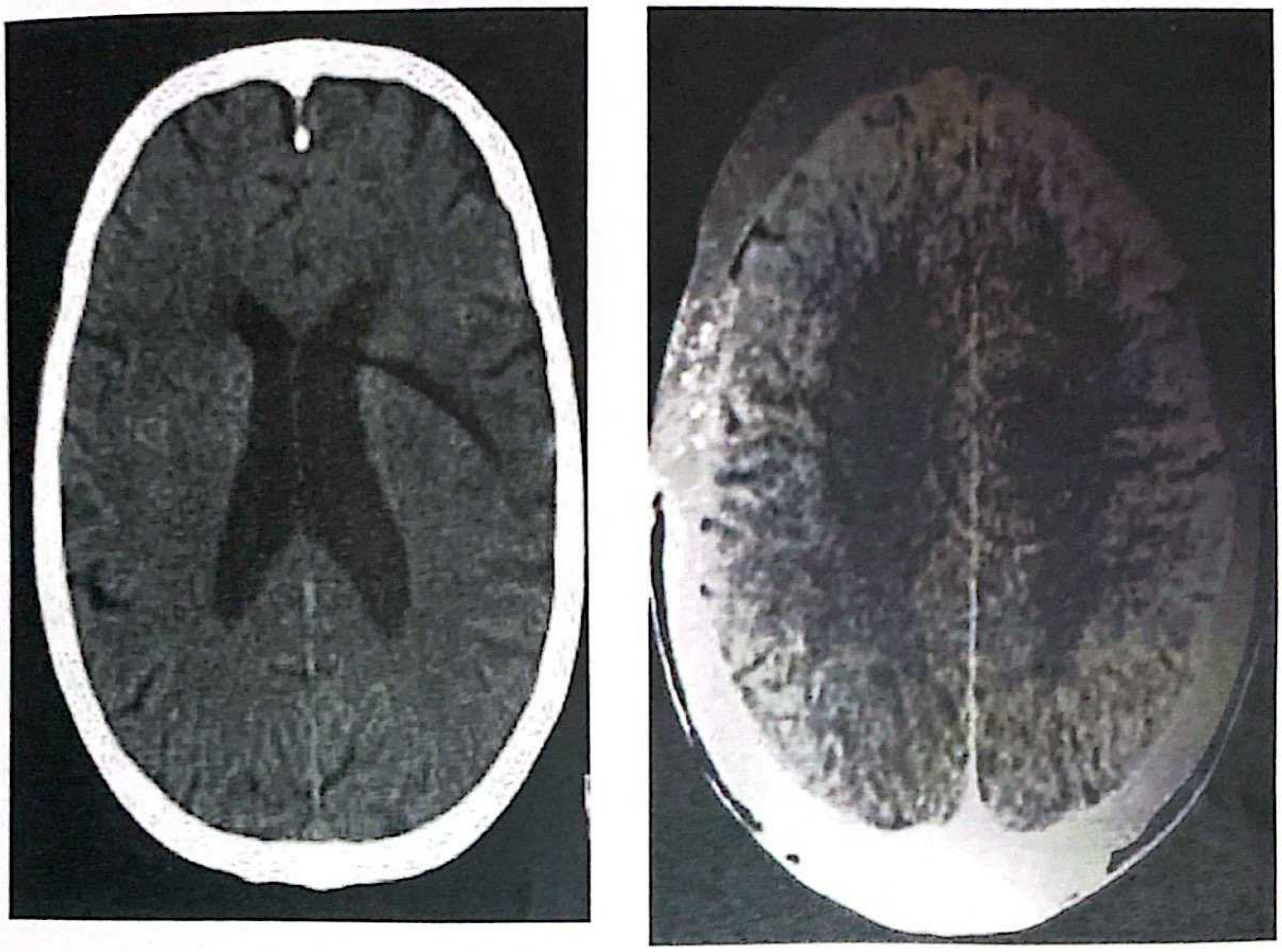


Name: Cone beam artefact
Modality: CT
Cause:

1. Blurring b/w high & low contrast detail
2. As number of sections acquired per rotation increase, X-ray beam becomes cone shaped instead of fan shaped so off axis objects b/w cones cause partial volume effect
3. Worse with increasing number of detector rows

Correction:
Software correction (cone beam reconstruction)

Q.6)



Name: Ring artefact
Modality: CT
Cause:

1. Circular artefacts are seen if one detector is out of calibration in 3rd generation scanner, that detector will give a consistent error at each angular position
2. Solid state detectors are more susceptible than gas(xenon)detectors

Correction:

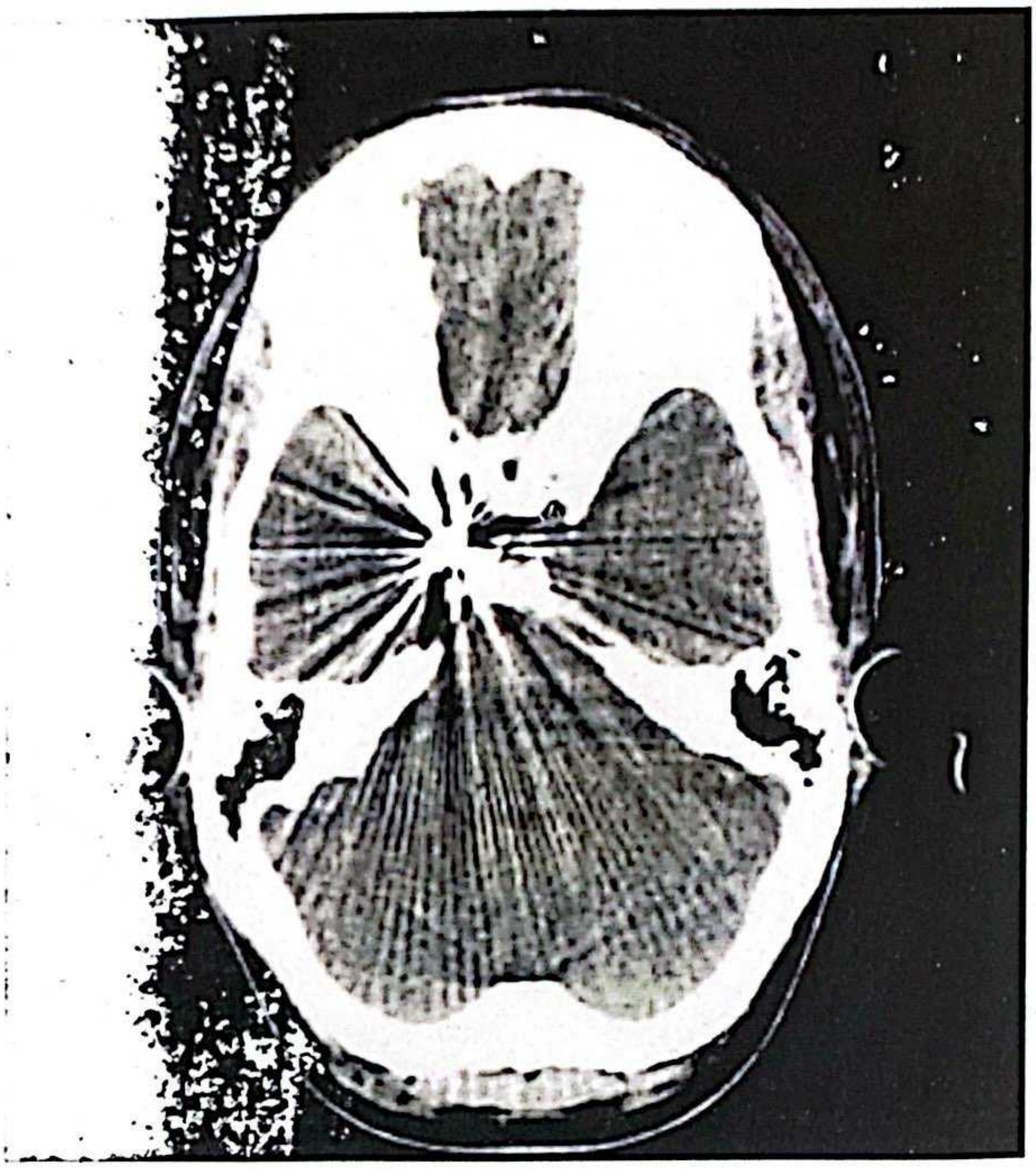
By manufacturer:

1. Recalibrate detector gain
2. Repair detector
3. Software correction

By operator:

1. Correct field of view

Q.7) Identify? **(2017)**



Name: Metallic Streak artifact/Star Artifact

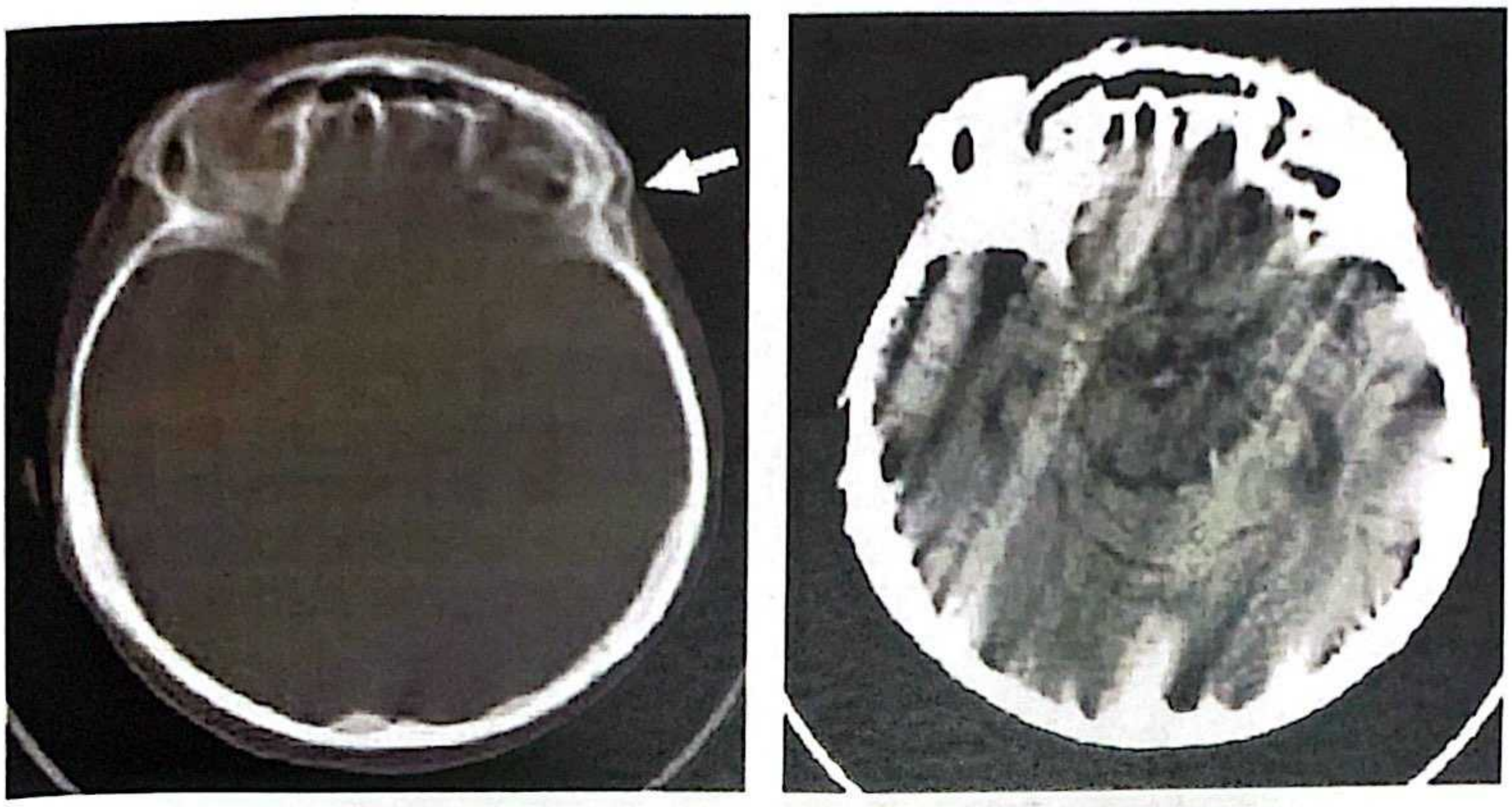
Modality: CT

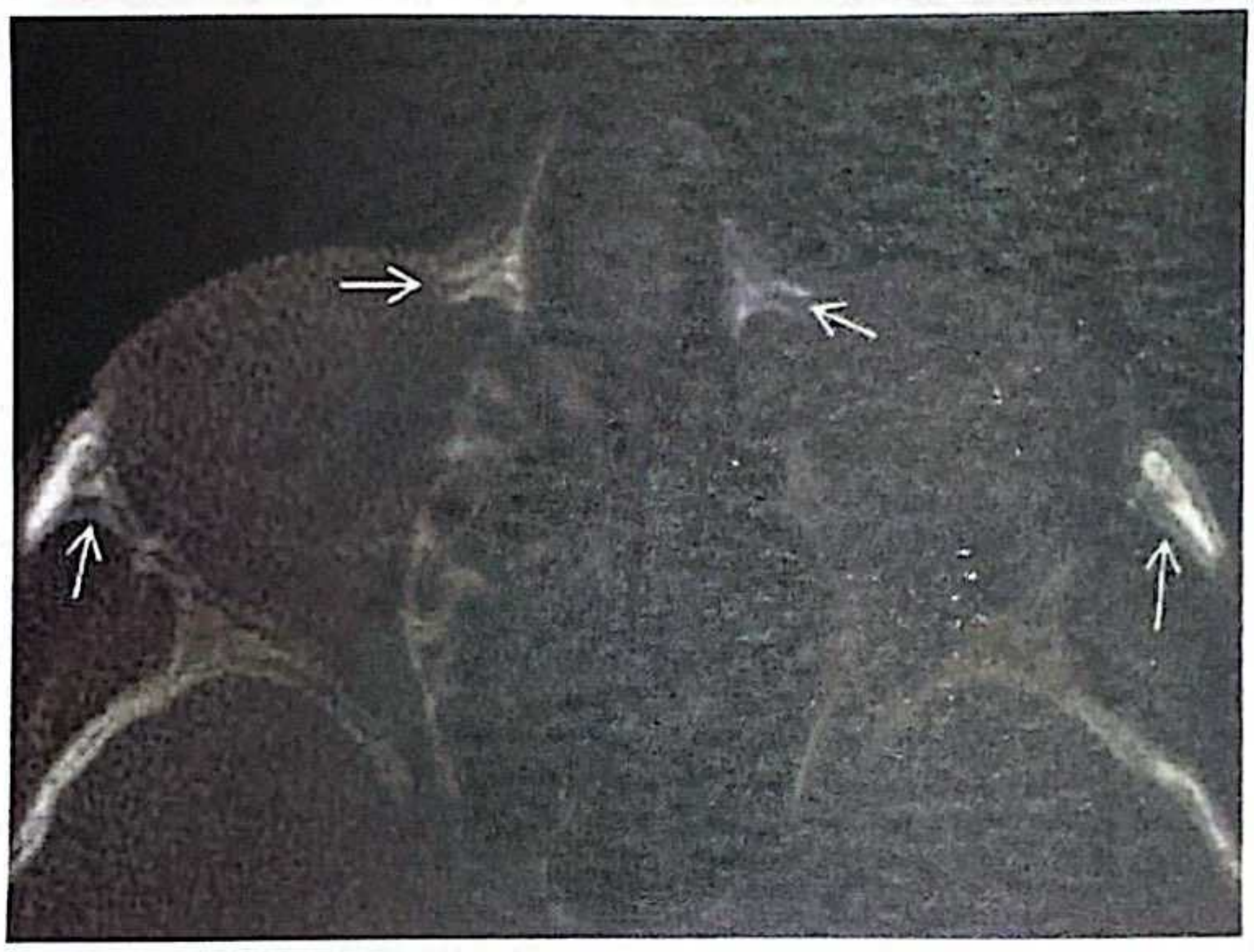
Cause: Metal implants, dental amalgam, etc.

The streaks appear as dark and light lines emanating from the highattenuation material. The effect is accentuated by motion. Small areas of bone or contrast medium can have a similar effect.

Correction: Modern scanners commonly include metal correction algorithms that can be used to minimize the appearance of this artefact

Q.8)





Name: Motion Artifact
Modality: CT
Cause: Mis registration of data by Voluntary & involuntary movements

Correction:

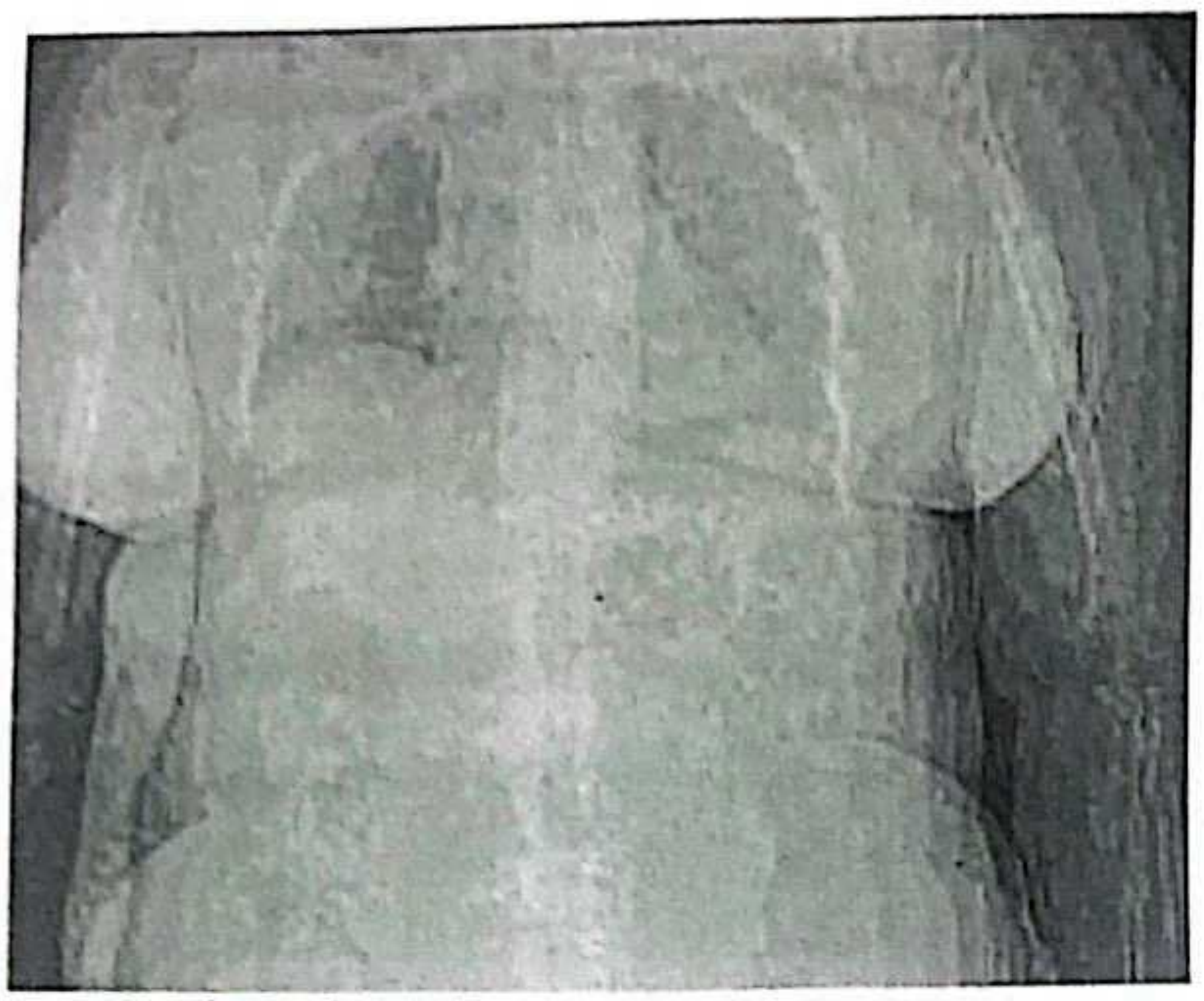
By manufacturer:

1. Overscan and underscan modes
2. Software correction
3. Cardiac gating

By operator:

1. Positioning aids (for voluntary)
2. Sedation (Specially in peads)
3. Hold breath techniques
4. Minimize scanning time

Q.9)



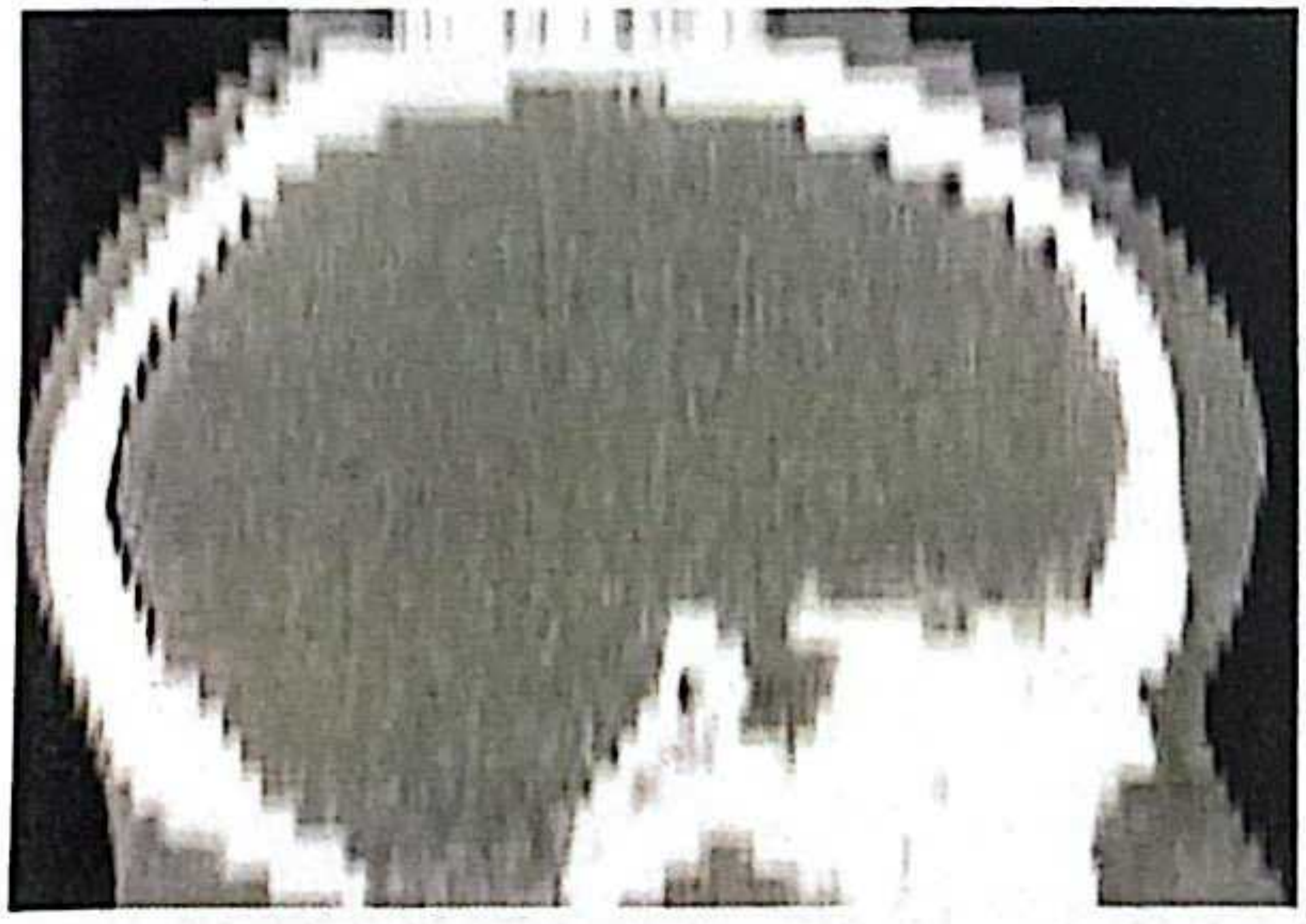
Name: Incomplete projection
Modality: CT Scanno
Cause: Incomplete information regarding portion outside scan field of view
Correction:
By manufacturer:

1. Monitoring of reference data channels
2. Specially designed reference CT detectors

By operator:

1. Proper positioning

Q.10)



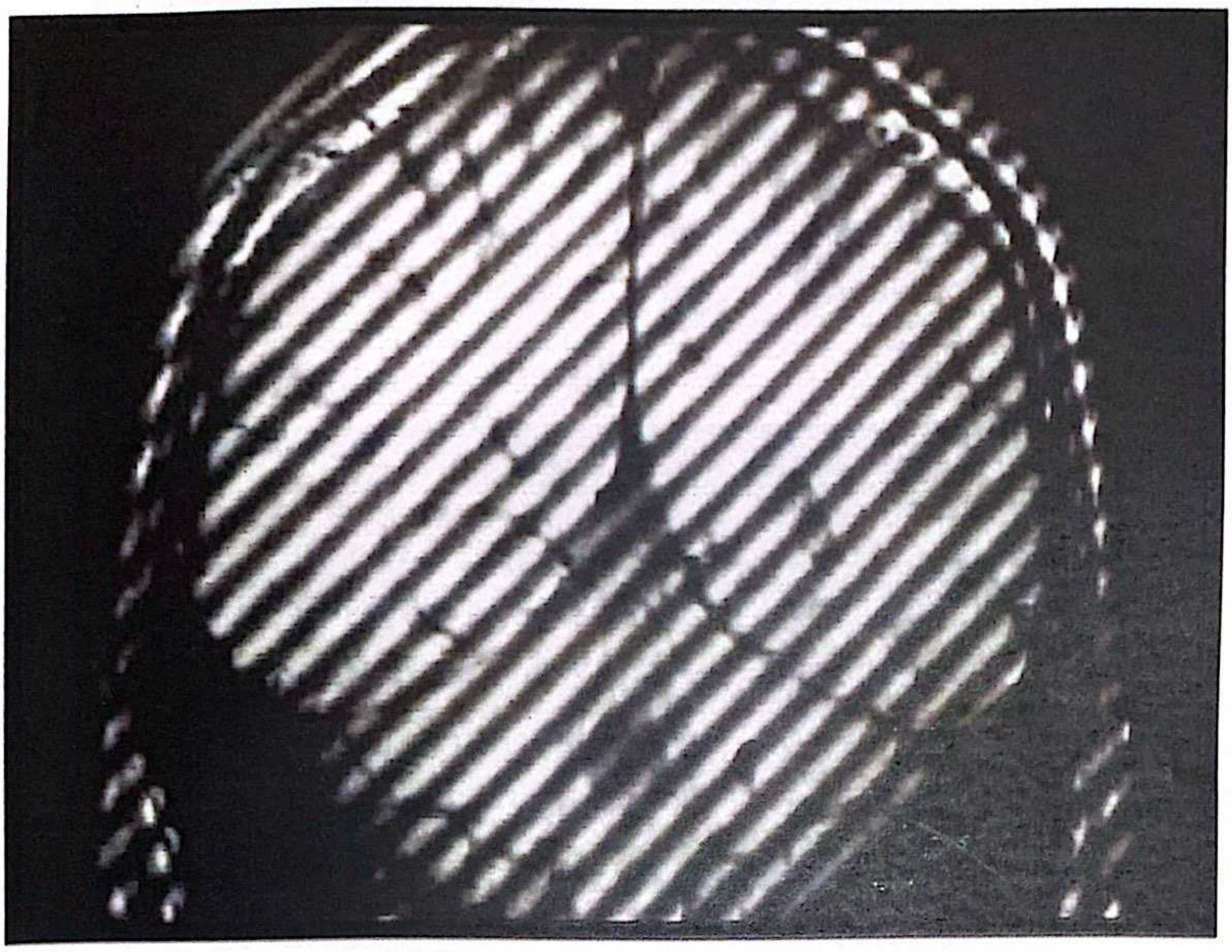
Name: Stair step artefact
Modality:
Cause:

1. Occurs in straight structures oriented obliquely with respect to table movement e.g skull
2. When wide collimation & non-overlaping reconstruction interval is used in multiplanner & 3D reconstruction.

Correction:

1. Thin sections (smaller collimation)
2. Overlaping reconstruction in helical imaging

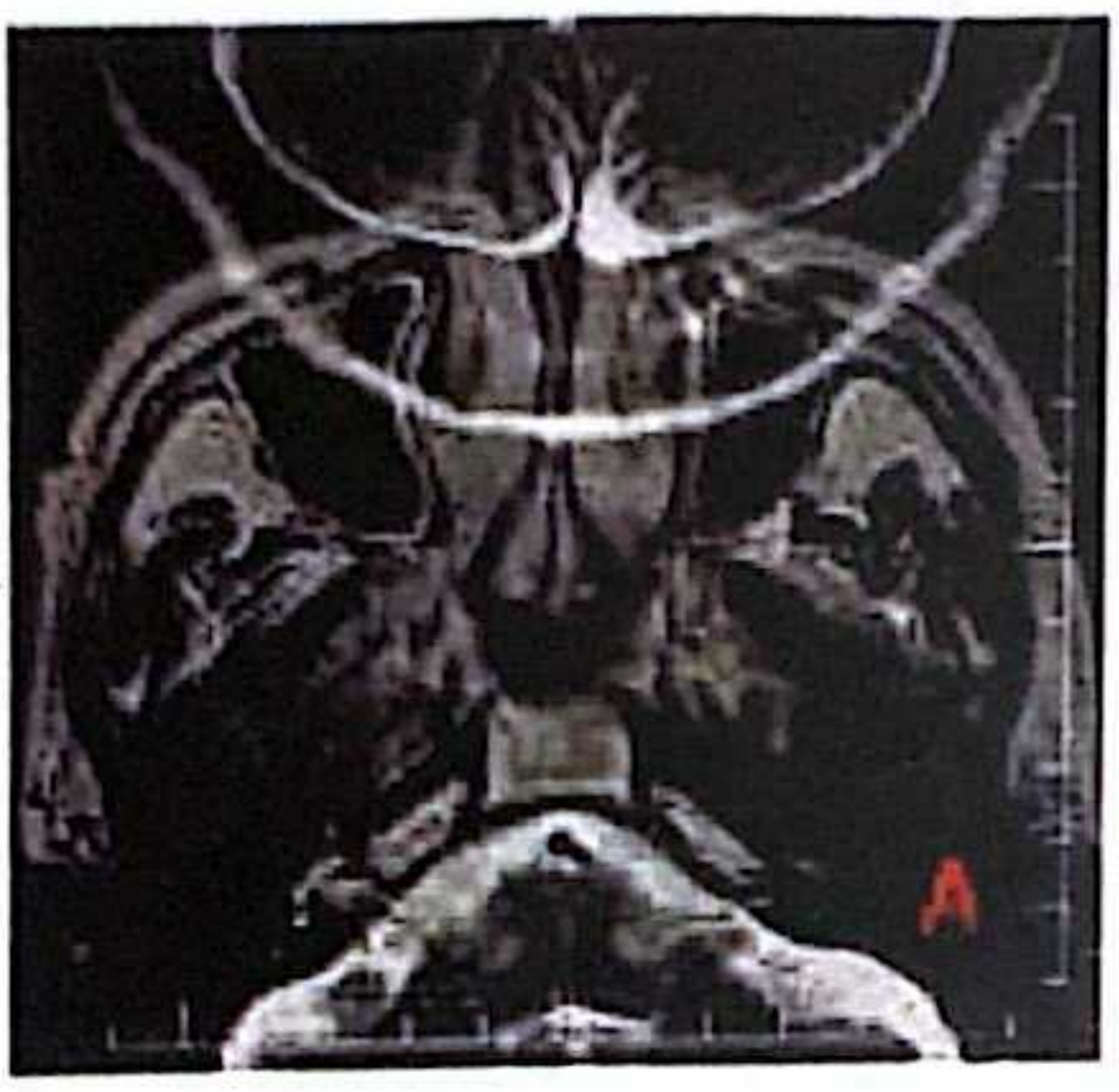
Q.11)

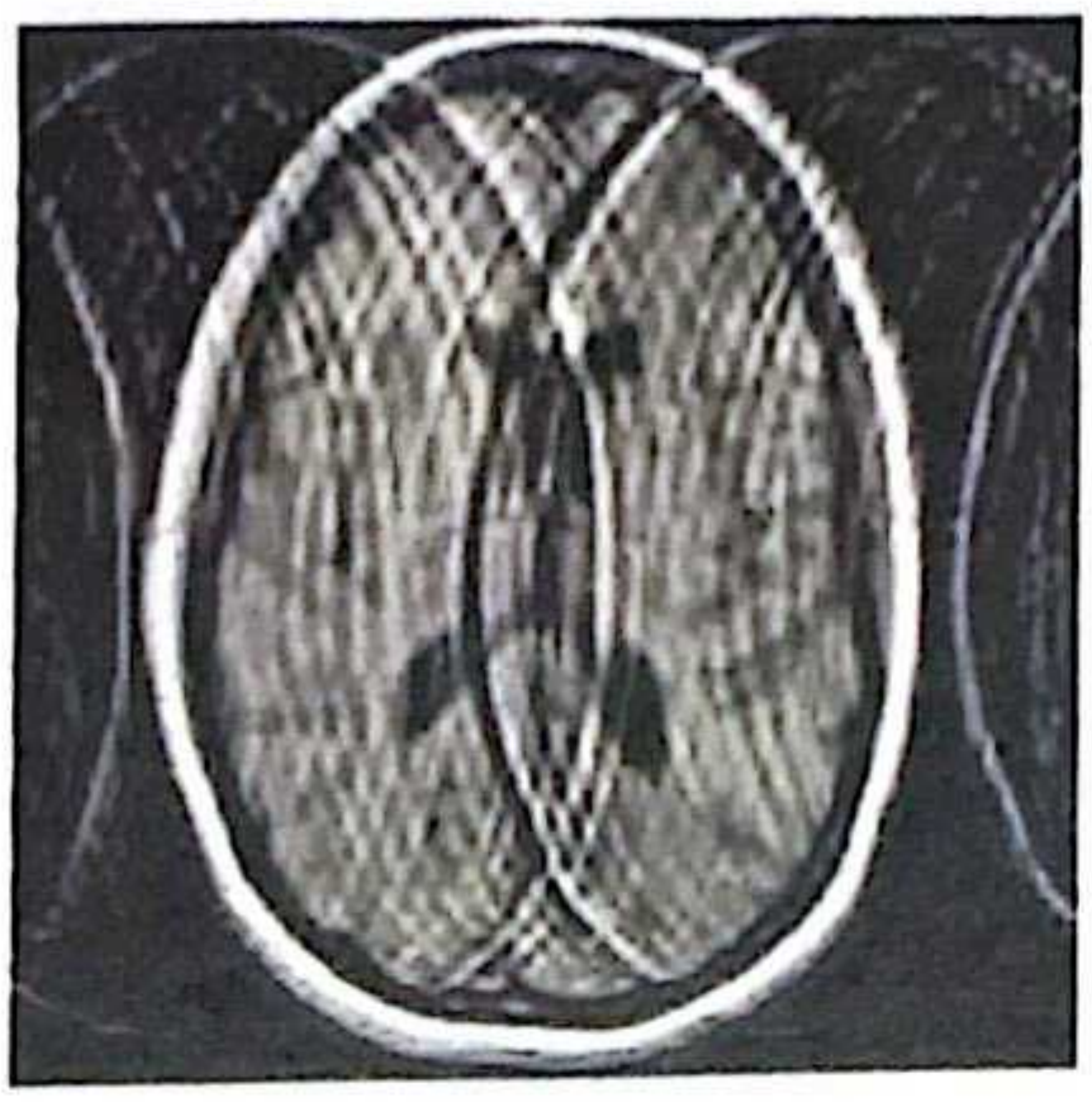


Name: Zebra
Modality: CT
Cause:
Helical interpolation in 3D reformatted images give rise to a degree of noise inhomogeniety along Z-axis
Note: Zebra sign is also noted from hemorrhage in the cerebellar sulci
Correction:
Reformatting software

MRI ARTIFACTS

Q.1) Identify? **(2016)**





A:

Name: Aliasing/Wrap around

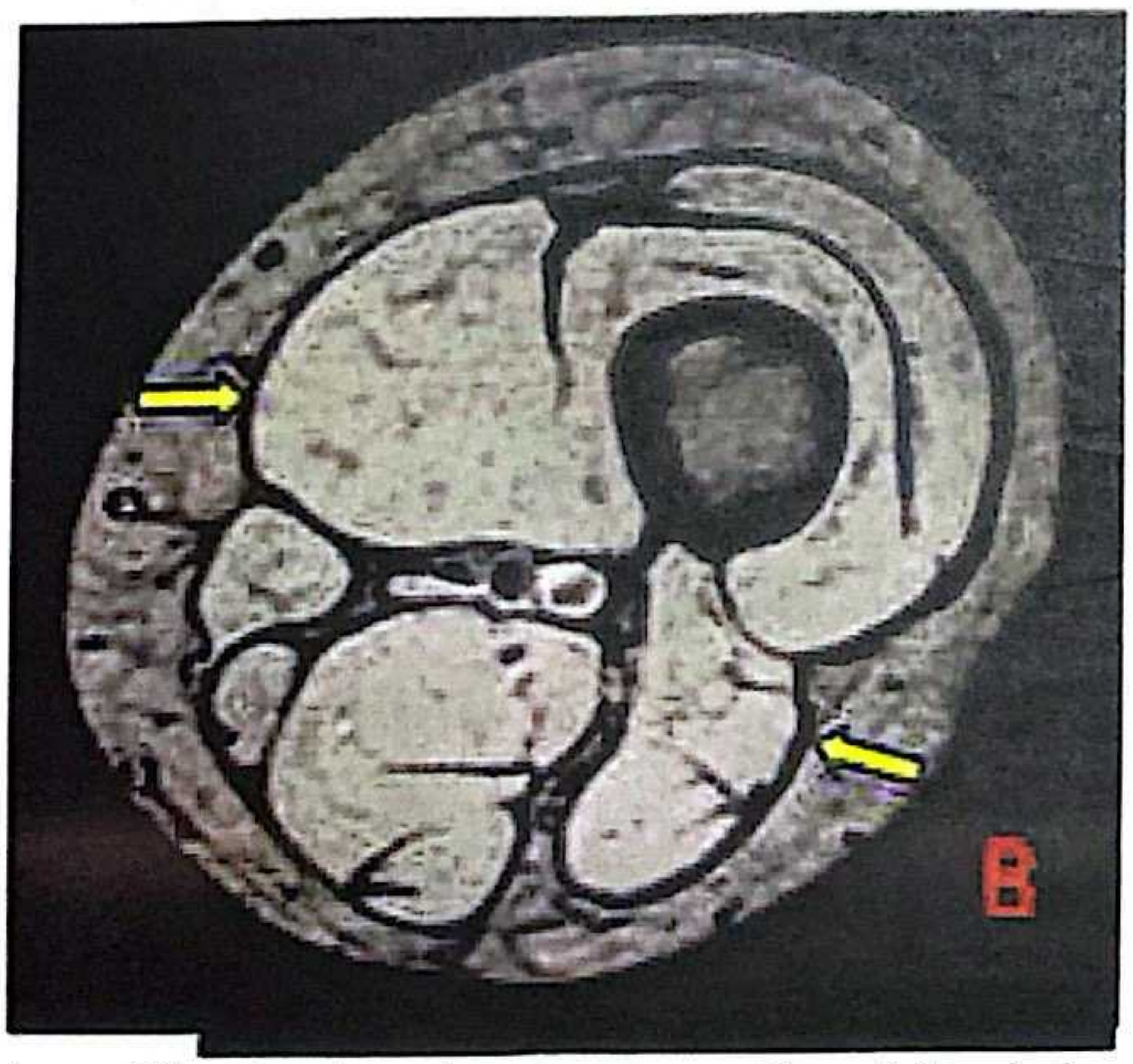
Modality: MRI

Cause:

1. Caused by a small FOV
2. Part of patient excited by RF overlaps
3. Signals picked up by the body coil outside FOV area
4. Allocated to pixels within matrix

Correction:

1. Increase the field of view
2. Change the phase encoding direction
3. Match surface coil



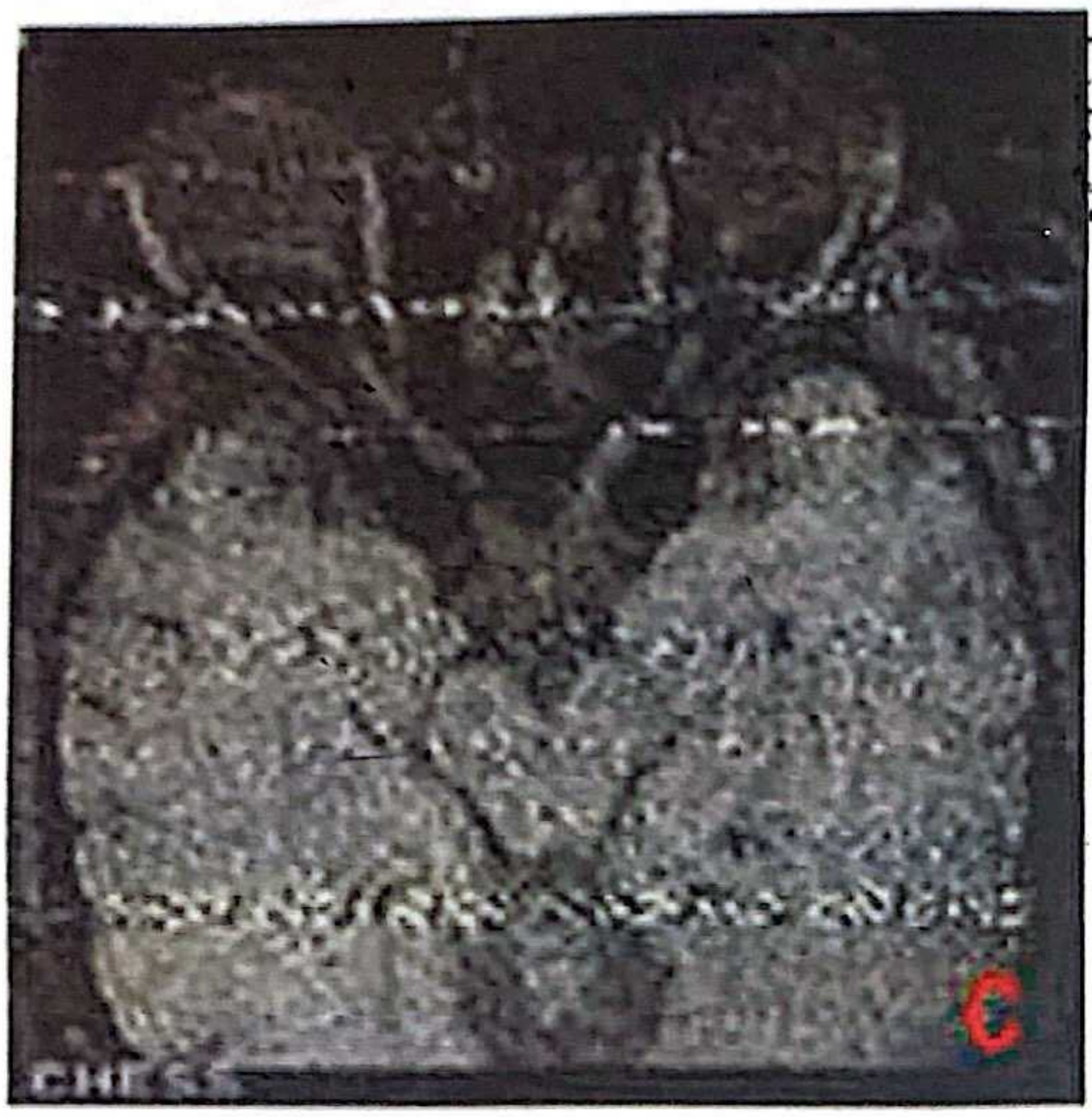
B:

Name: India ink artifact also known as the black boundary artifact

Modality: MRI

Cause: Out-of-phase imaging and represents signal drop out in voxels that contain both fat and non-fat components. As such it is seen surrounding interfaces, lending the image an appearance as if someone has outlined these interfaces with ink.

Q.2) Identify?



C:

Name: Zipper Artifact

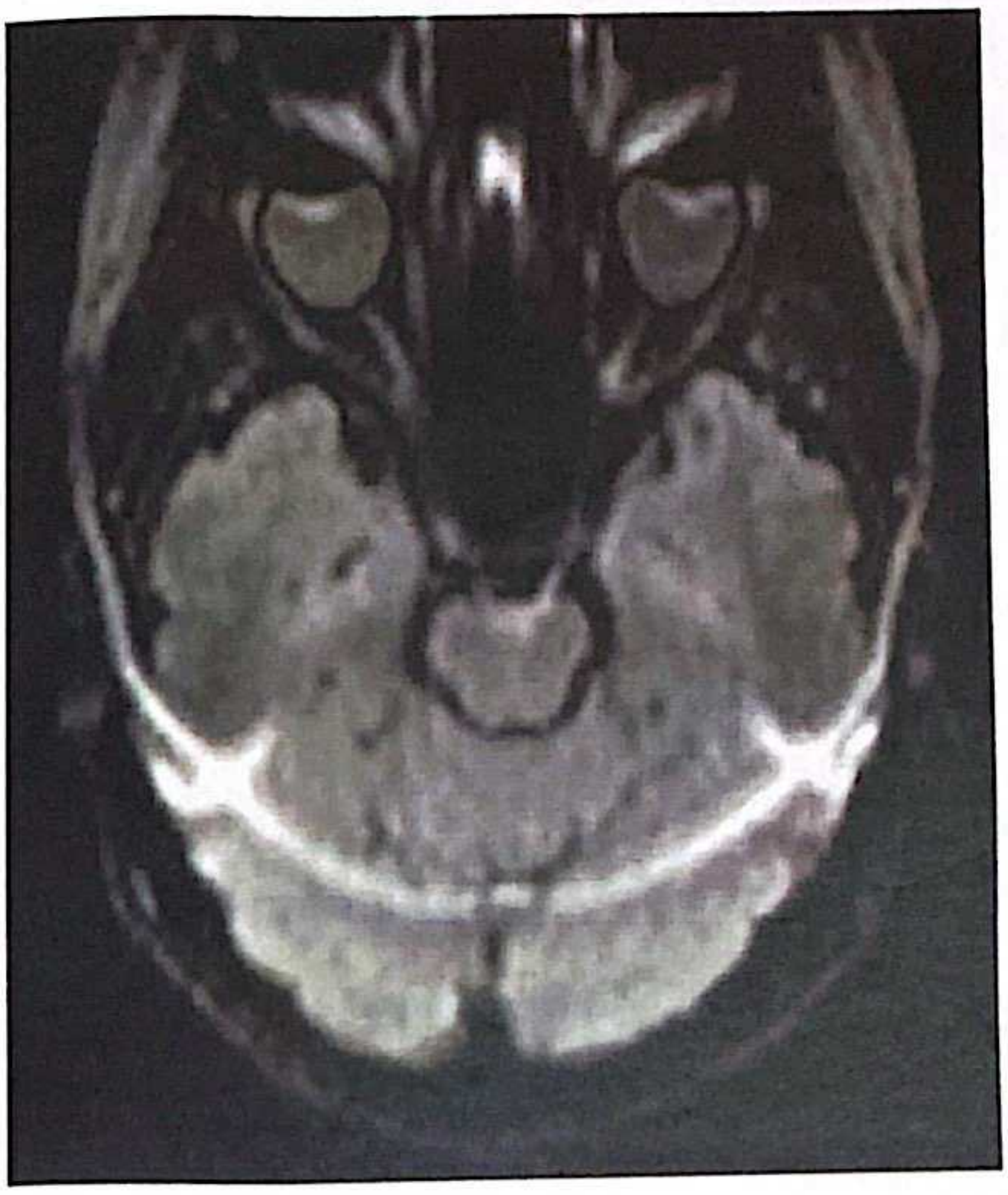
Modality: MRI

Cause:

1. In the phase-encoding direction when RF leaks from the transmitter to the receiver.
2. RF interference from outside, with the patient acting as an aerial
3. When the shielded door is ajar
4. Poor Shielding

Correction:

1. Better shielding arrangements
2. Remove electronic devices around



Name: Chemical shift

Modality: MRI Frequency Encoding

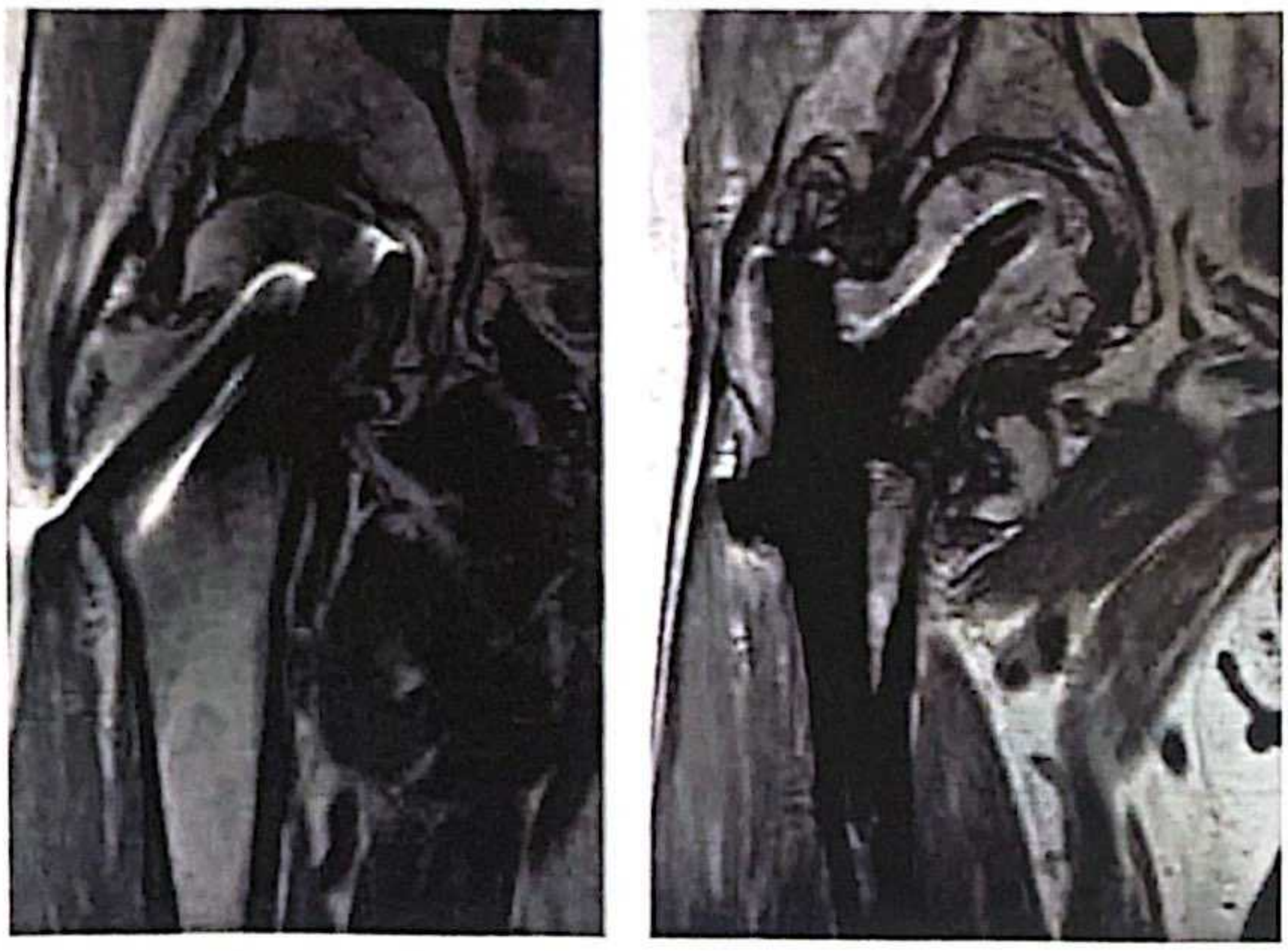
Cause:

1. Stronger Magnetic Field
2. Lower Receiver Bandwidth
3. Caused by differences in resonance frequencies

Correction:

1. Bigger Pixels
2. Fat Suppression
3. Increase Receiver Bandwidth

Q.3)



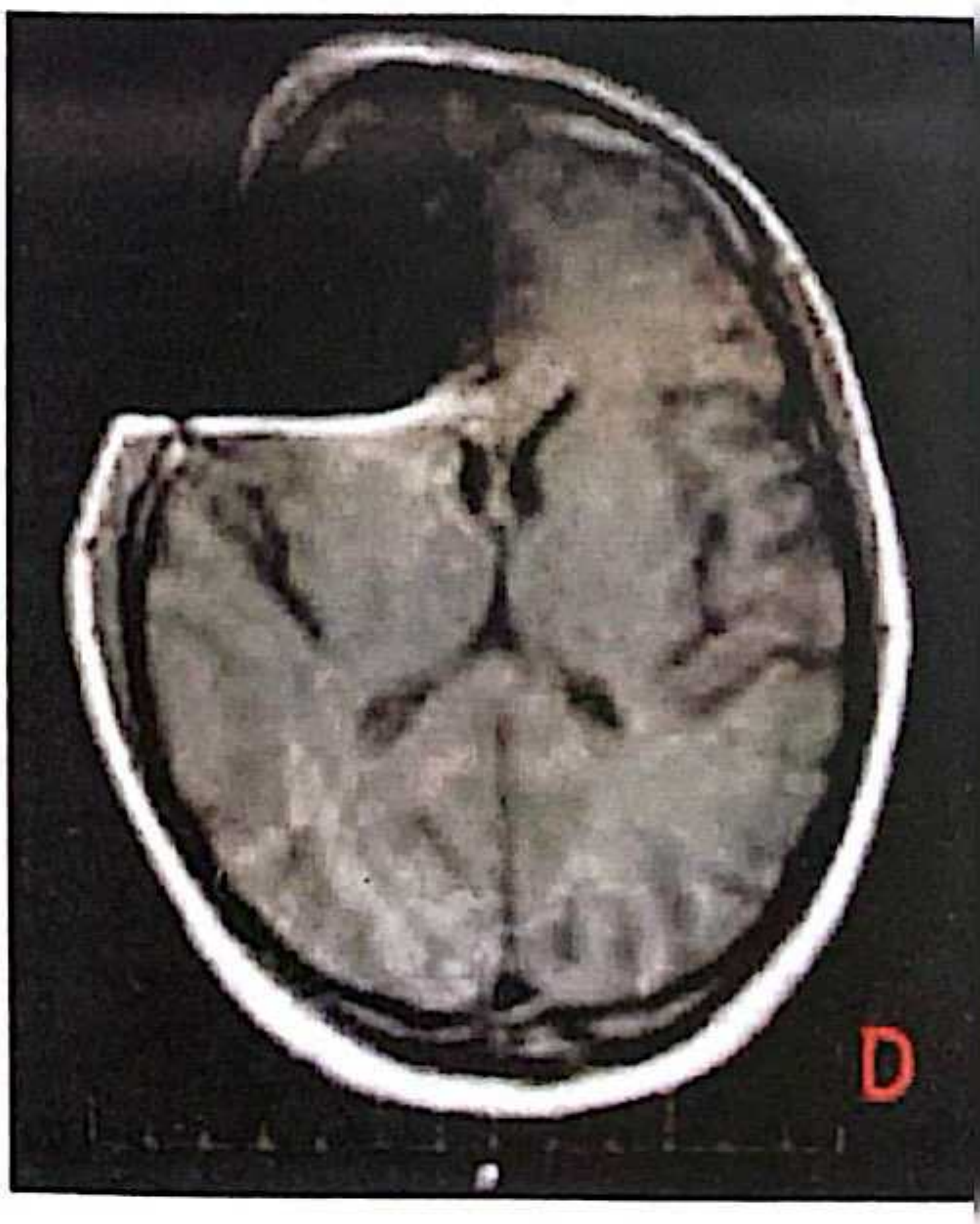
Name: Ferromagnetic Susceptibility

Modality: MRI

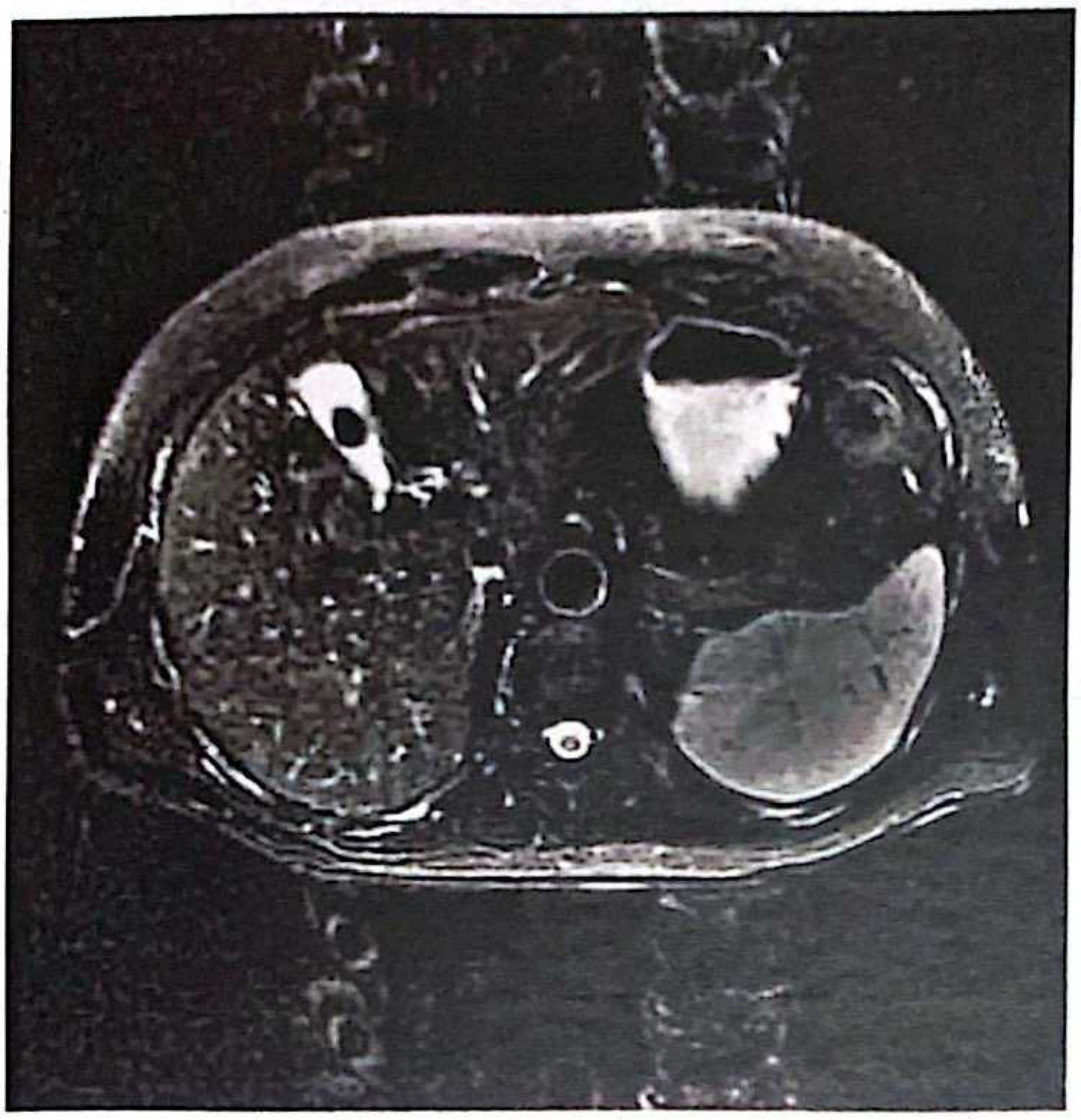
Cause:

1. Difference in time susceptibility causes field inhomogenietie between boundaries. This dephases spins faster faster resulting in low signal at boundaries
2. Echoplanar more susecptible
3. GRE images are more susceptible than SE

Correction:



1. Phase encoding along susceptibility gradient
2. Use Spin echo sequences
3. Proper shimming
4. Remove metallic object



Name: Motion artefact in phase encoding direction/Ghost Artifact

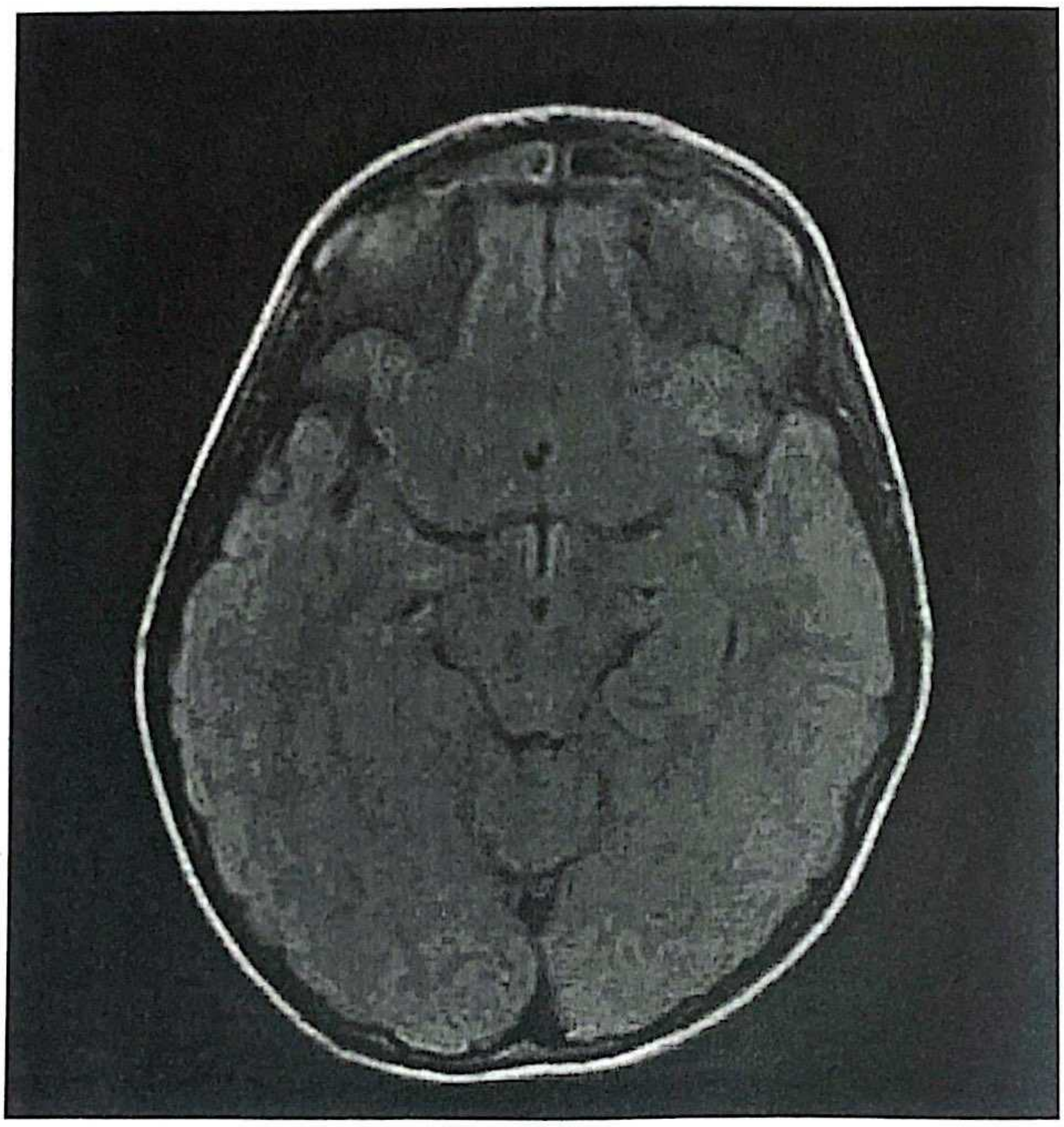
Modality: MRI

Cause: Blurring and ghosting in phase encoding direction

Correction:

1. Breath holding
2. Respiratory gating
3. ECG gating
4. Swipe frequency & phase encoding
5. Phase reordering
6. (e.g ROPE..respiratory ordered phase encoding)
7. Real time navigator echo gating

Q.4)



Name: Gibbs effect (truncation or ringing)

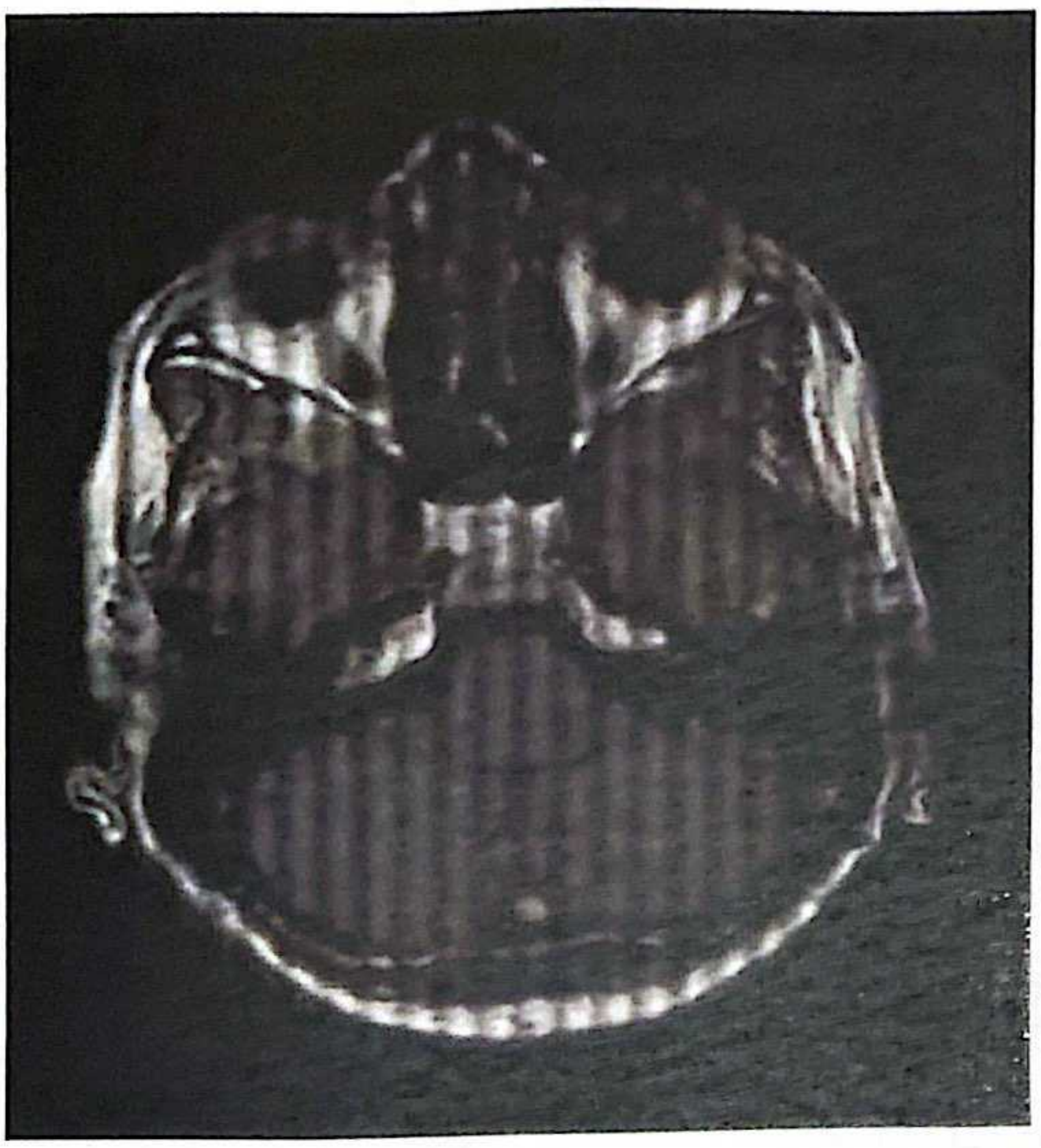
Modality: MRI

Cause: Insufficient collection of sample in phase encoding direction or readout direction

Correction:

1. Increase acquisition matrix size with unchanged FOV (but it will raise acquisition time and signal to noise ratio)
2. Increase phase encoding & decrease FOV

Q.5)



Name: Herringbone/spike artefact

Modality: MRI

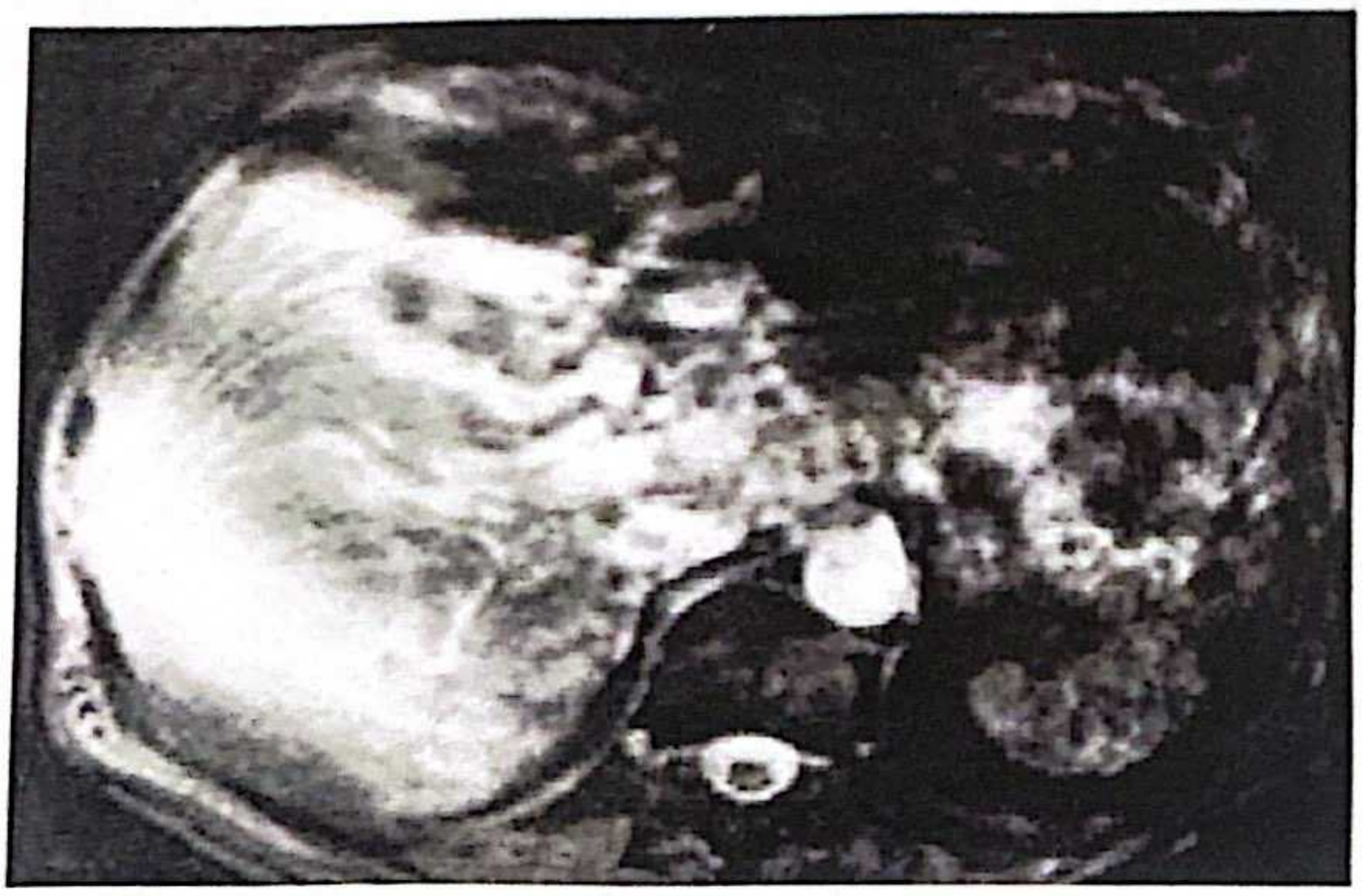
Cause:

1. Bad data points or spikes of noise in k-space resulting in a ray of high or low intensity compared with the intensity of the rest of k-space
2. Loose electrical connections
3. Breakdown of interconnections in RF coil

Correction:

1. Correct electrical connections
2. Correct RF coil

Q.6)



Name: Phase mismaping

Modality: MRI

Cause: Respiration

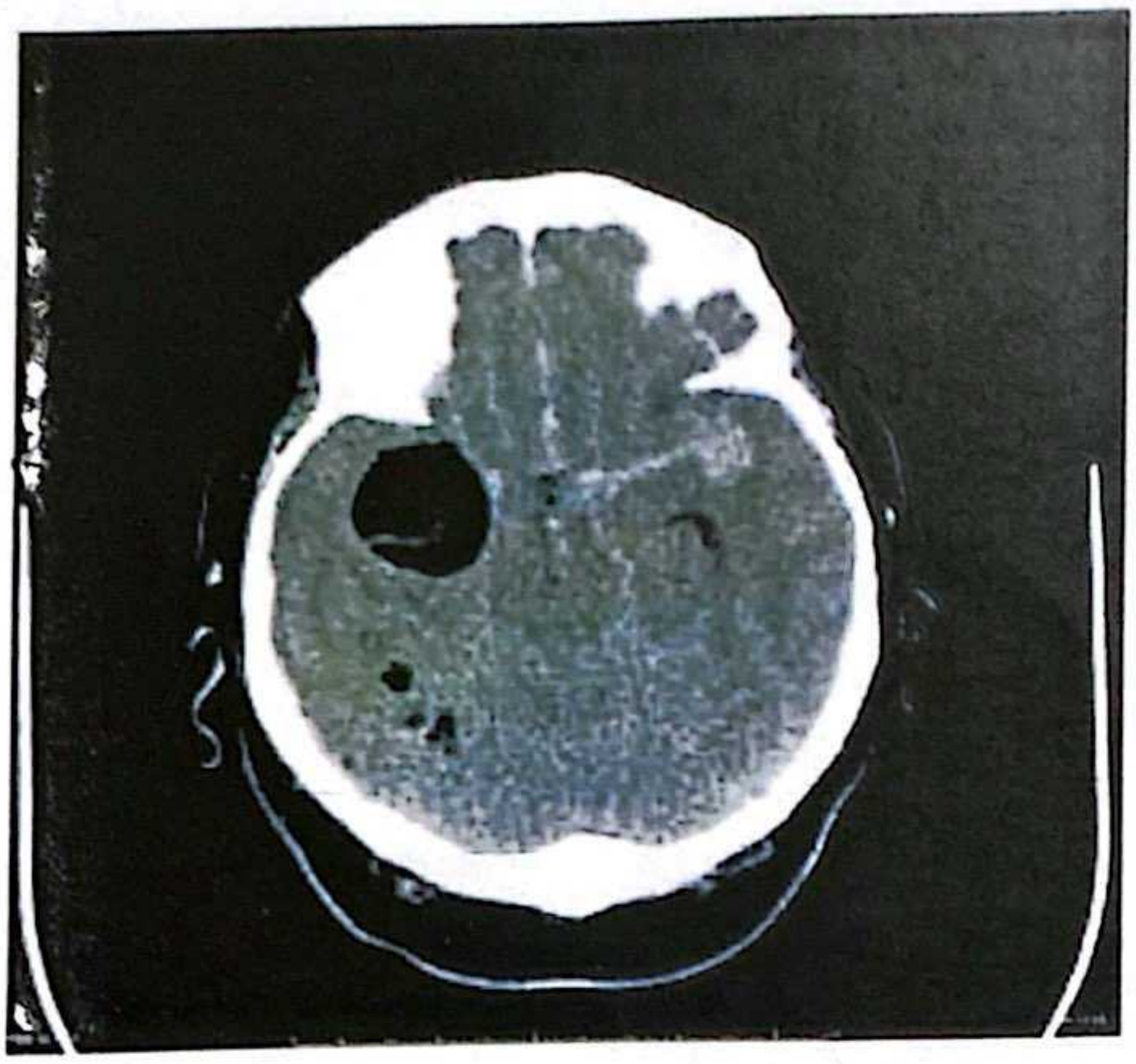
Correction:

1. Exchange phase & frequency directions
2. Use gating

1 a
co2 mg.

CENTRAL NERVOUS SYSTEM

Q.1) Presentation: Acute headache. Age: 60-Female (2018)



Identify: Unenhanced CT Brain Axial view

Describe: Hyperattenuating material is seen filling the left sylvian cistern and left convexity, and small amount of hyperintensity in the third ventricle and occipital horns. There is mild hydrocephalus.
Well defined low attenuating (fat density) lobulated mass in right parasellar region

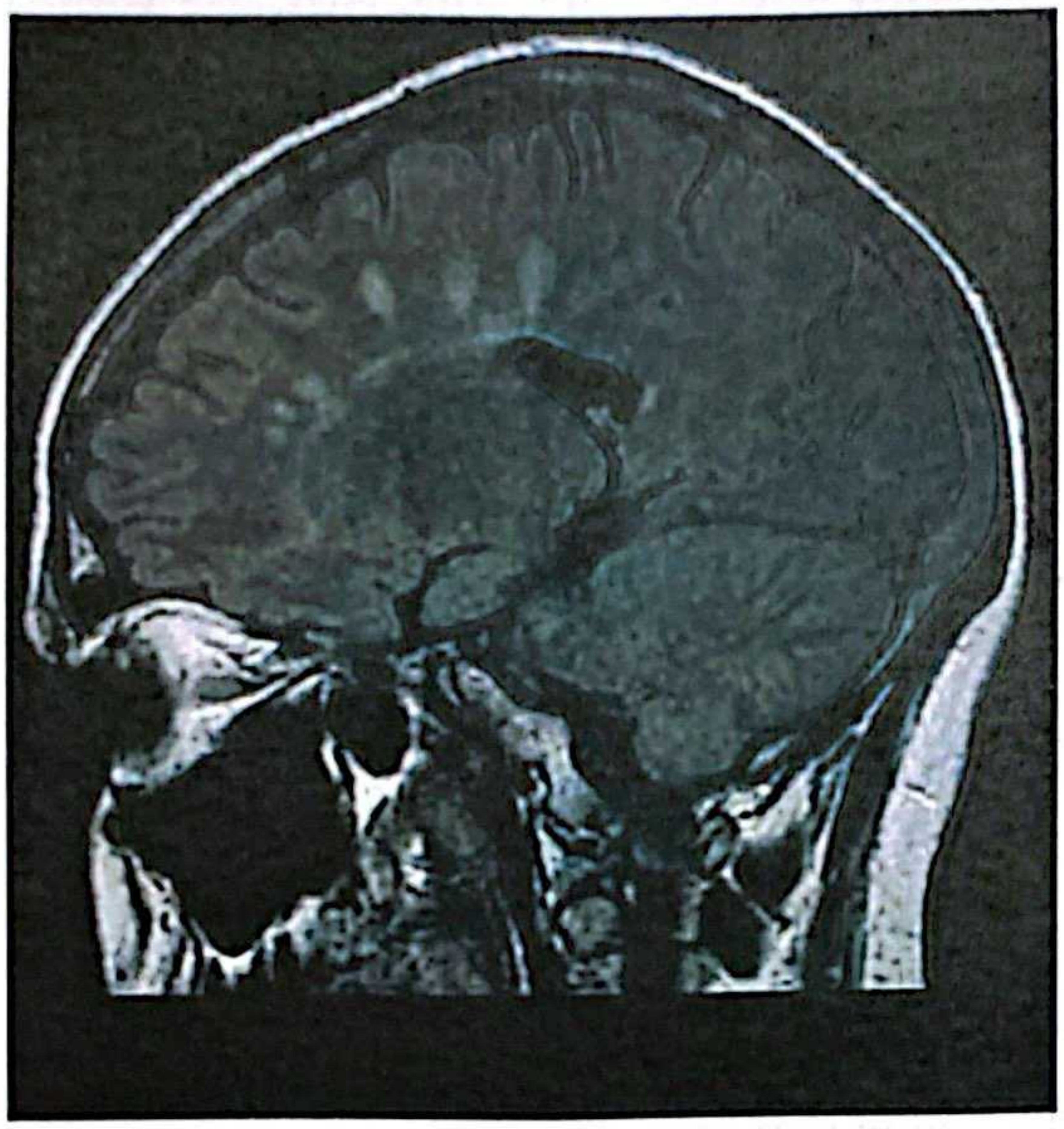
Diagnosis: There is acute subarachnoid haemorrhage, with a moderate amount of blood seen filling the left sylvian cistern and left convexity. Findings are suspicious for a left MCA trifurcation aneurysm. There is also a ruptured right parasellar dermoid cyst, that measures 3.2 cm in size.

What next: Cerebral Angiography, DSA (ANGIOGRAPHY)

Differentials:

1. Intracranial lipoma
- homogeneous fat attenuation/signal intensity
- chemical shift artefact
2. Intracranial epidermoid cyst
- attenuation similar to CSF
- restricted diffusion on DWI
3. Intracranial teratoma: immature
- usually occur in the pineal region
4. Craniopharyngioma
- most are strikingly hyperintense on T2
- most enhance strongly

Q.2) Spot Diagnosis **(2015) (2016)**



Identify: MRI Brain Sagittal View FLAIR Sequence
Describe: Multiple white matter plaques, some of them are penpendicular to the corpus callosum giving the appearance of Dawson fingers
Diagnosis: Multiple sclerosis
What next:

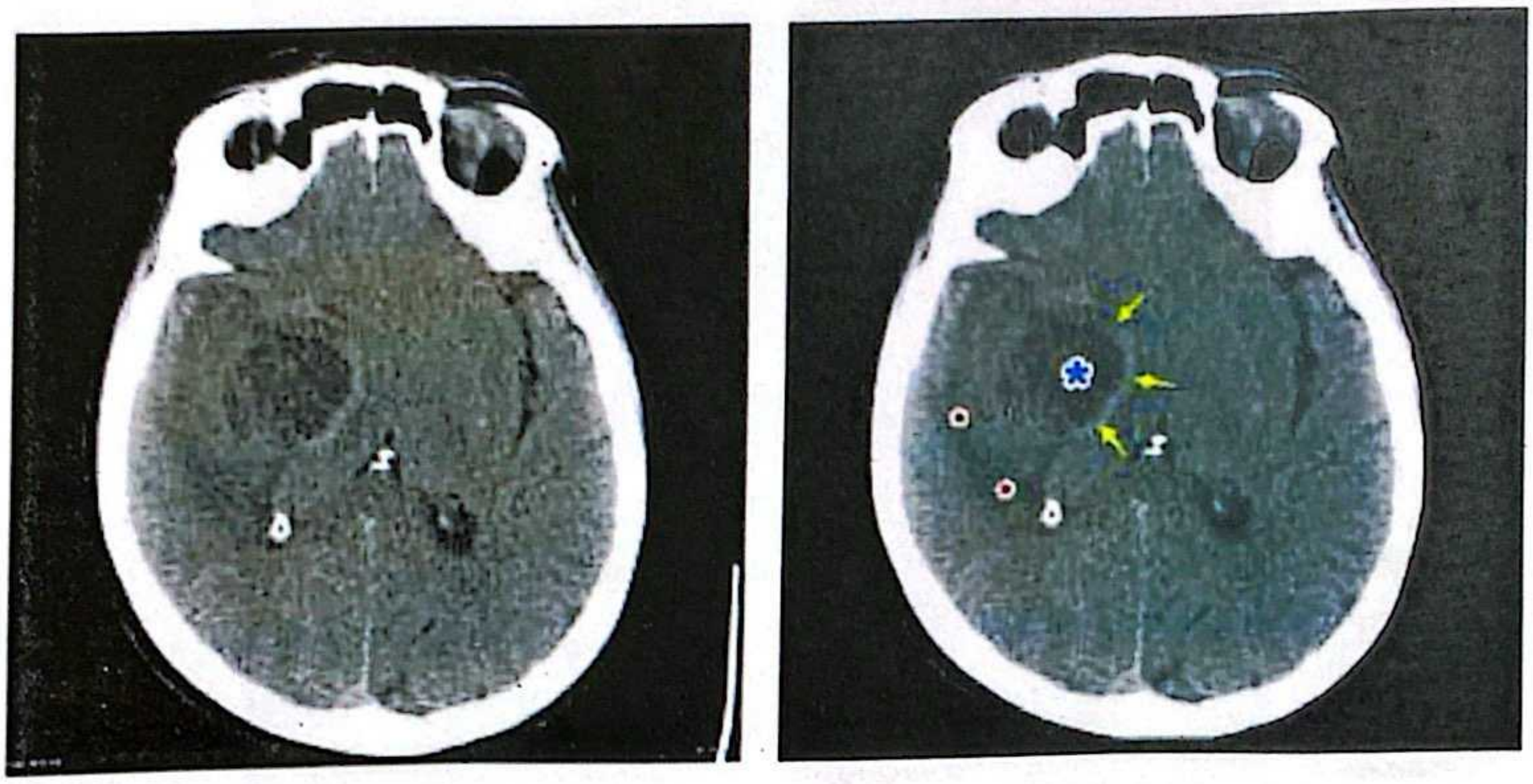
- MR spectroscopy**:** NAA peaks may be reduced within plaques, which is the most common and remarkable finding choline and lactate are found to be increased in the acute pathologic phase
- Double inversion recovery DIR: A new sequence that suppresses both CSF and white matter signal and offers better delineation of the plaques.

Differentials:

1. CNS fungal infection (e.g. Cryptococcus neoformans) - patients tend to be immunocompromised mucopolysaccharidosis (e.g. Hurler disease) - congenital and occurs in a younger age group
2. Marchiafava-Bignami disease (for callosal lesions)
3. Susac syndrome
4. CNS manifestations of primary antiphospholipid syndrome

Q.3) Presentation: Increasing headaches and unsteadiness. History of breast cancer 2 years ago treated with lumpectomy and radiotherapy. AGE: 65 years-Female

(2017)



Identify: Unenhanced CT Brain Axial view

Describe: A large heterogeneous mass is centred into the right temporal lobe, elevating the MCA vessels in the Sylvian fissure and resulting in uncal herniation which in turn pushes the midbrain towards the left. The mass has central non-enhancing liquid density components, and irregular peripheral enhancement. It is surrounding by vasogenic pattern oedema.

The mass in the right temporal lobe has a liquid (necrotic) centre (blue *) surrounded by a slightly hyperdense irregular rim (yellow arrows) which enhances following contrast administration. The whole mass is surrounded by low density change in the white matter (red *) consistent with oedema.

There is significant mass effect with shift of the brain's midline to the left (dotted green line).

Diagnosis: Glioblastoma NOS (not otherwise specified)

What next:

MRI

T1

- hypo to isointense mass within white matter
- central heterogeneous signal (necrosis, intratumoural haemorrhage)

T1 C+ (Gd)

- enhancement is variable but is almost always present

- typically peripheral and irregular with nodular components
- usually surrounds necrosis

T2/FLAIR

- hyperintense
- surrounded by vasogenic oedema
- flow voids are occasionally seen

GE/SWI

- susceptibility artefact on T2* from blood products (or occasionally calcification)
- Low-intensity rim from blood product 6
- incomplete and irregular in 85% when present
- mostly located inside the peripheral enhancing component
- absent dual rim sign

DWI/ADC

- solid component
- elevated signal on DWI is common in solid/enhancing component
- diffusion restriction is typically intermediate similar to normal white matter, but significantly elevated compared to surrounding vasogenic oedema (which has facilitated diffusion)

MR perfusion: rCBV elevated compared to lower grade tumours and normal brain

MR spectroscopy

- choline: increased
- lactate: increased
- lipids: increased
- NAA: decreased
- myoinositol: decreased

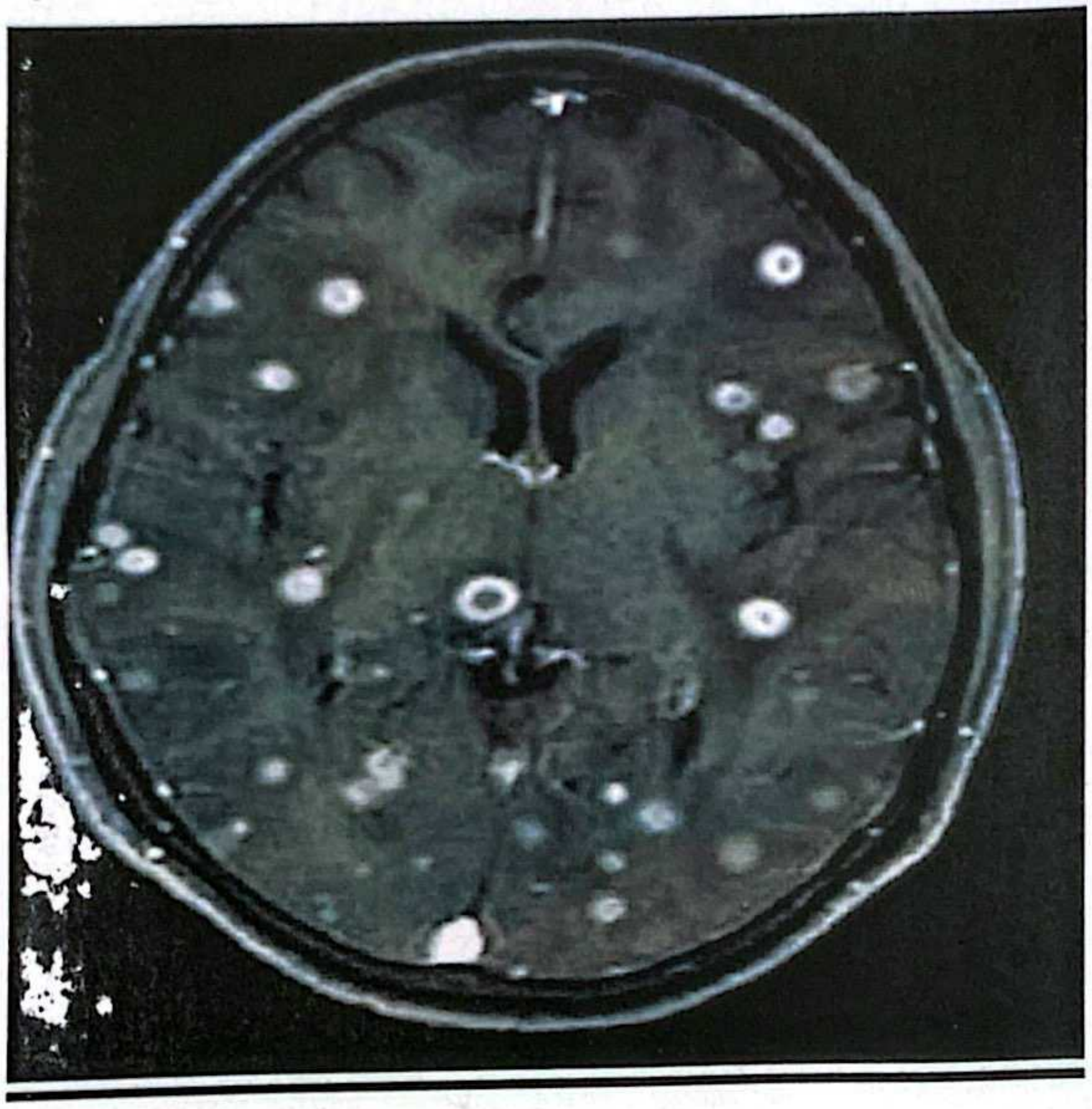
PET

- PET demonstrates accumulation of FDG (representing increased glucose metabolism) which typically is greater than or like metabolism in grey matter.

Differentials:

1. Cerebral metastasis
2. Primary CNS lymphoma
3. Cerebral abscess
4. Anaplastic astrocytoma
5. Cerebral toxoplasmosis

Q.4) Spot Diagnosis (2017)



Identify: T1 Axial Section of Contrast Enhanced MRI Brain

Describe: Multiple ring enhancing granulomas scattered throughout the brain

Diagnosis: MRI of the brain demonstrate numerous ring enhancing lesions. CSF can confirm TB. The lesions thus can represent numerous tuberculomas.

What next: MR spectroscopy

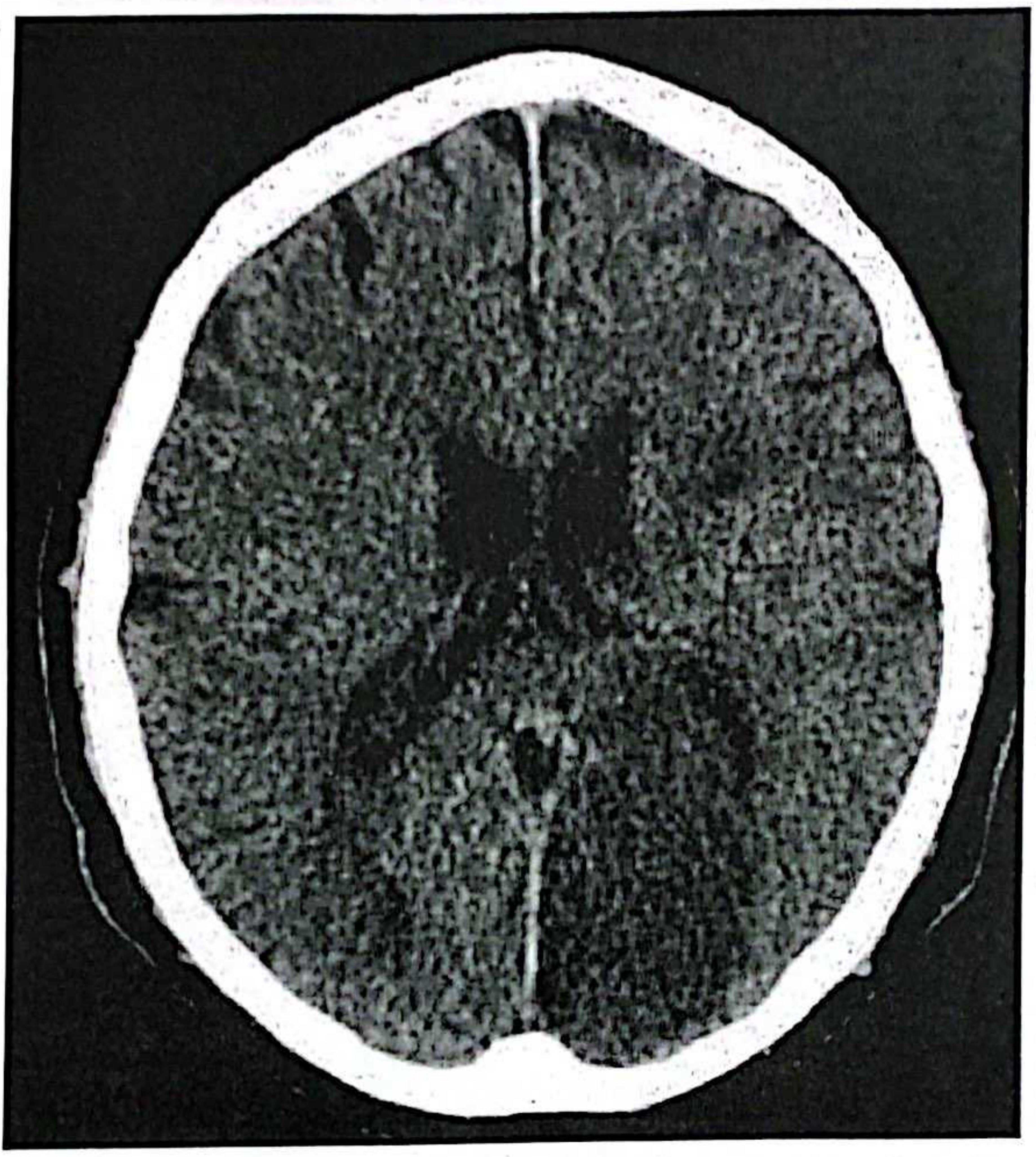
- Decrease in NAA/Cr
- Slight decrease in NAA/Cho
- Lipid-lactate peaks are usually elevated (86%)

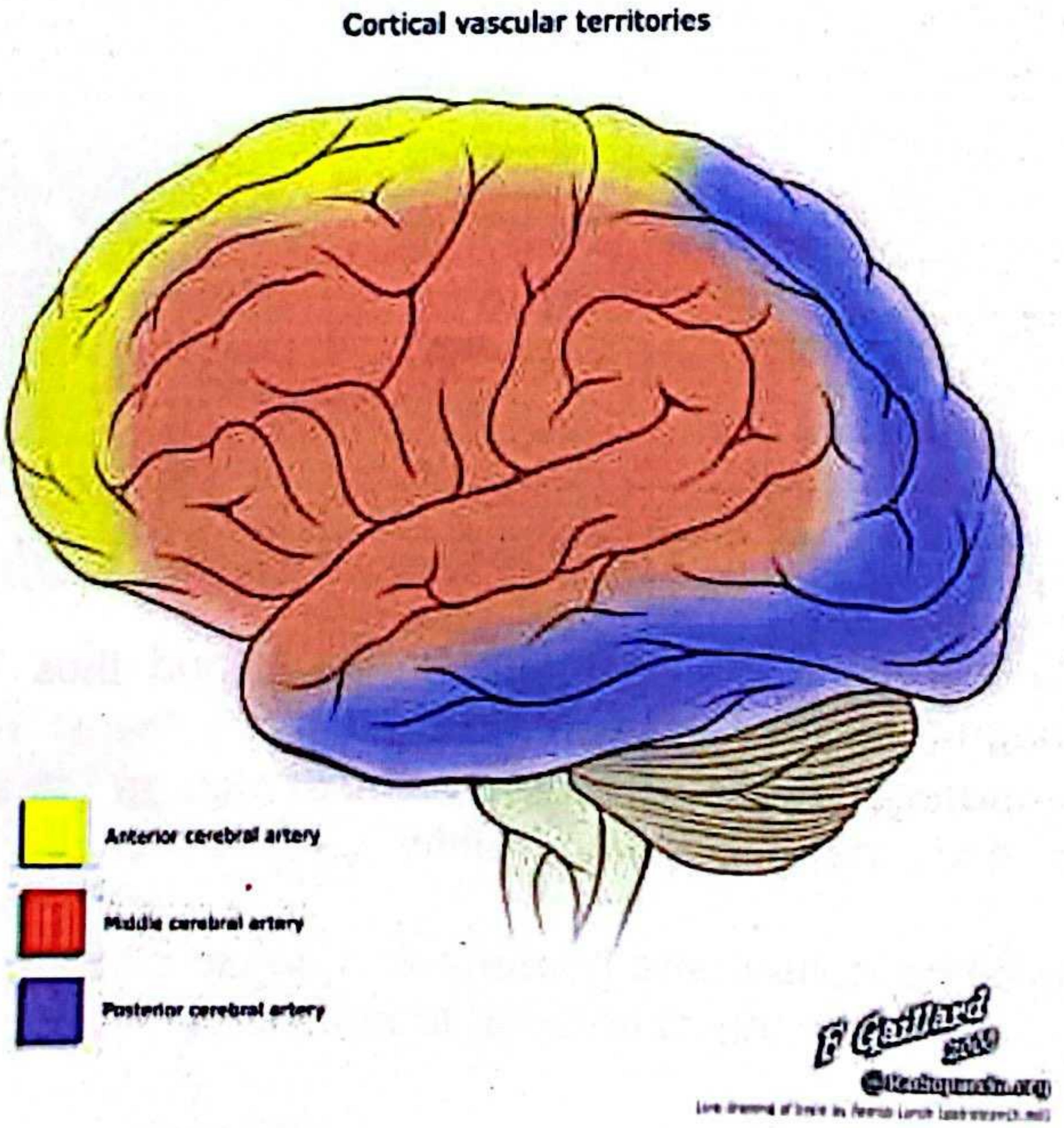
Differentials:

Mnemonic for Ring Enhancing Lesions is **MAGICAL DR**

D: demyelinating disease
R: radiation necrosis or resolving haematoma
M: metastasis
A: abscess
G: glioblastoma
I: infarct (subacute phase)
C: contusion
A: AIDS
L: lymphoma

Q.5) **Sudden onset visual disurbance. Mild ataxia and loss of balance. AGE: 70-Male** **(2017)**




Cortical vascular territories
Anterior cerebral artery
Middle cerebral artery
Posterior cerebral artery
F Gaillard
2009
©Radiopaedia.org

Identify: Unenhanced CT Brain Axial view

Describe: Hypodensity in left occipital and parietal lobes. Sulcal effacement in this area but no midline shift

Diagnosis: Left Posterior cerebral artery (PCA) infarct

What next:

CT angiography (CTA)

CT perfusion Imaging

Normal perfusion parameters are:

Gray matter

- MTT: 4 s
- CBF: 60 ml/100 g/min
- CBV: 4 ml/100 g

White matter

- MTT: 4.8 s
- CBF: 25 ml/100 g/min
- CBV: 2 ml/100 g

FLAIR MRI

Diffusion weighted imaging (DWI)

The appearance of DWI/ADC depends on the timing.

Acute (0-7 days)

- ADC value decreases with maximal signal reduction at 1 to 4 days
- Marked hyperintensity on DWI (a combination of T2 and diffusion weighting), less hyperintensity on exponential images, and hypointensity on ADC images

Subacute (1-3 weeks)

- ADC pseudonormalisation occurs in the second week (7-15 days)
- ADC values to rise and return to near baseline
- irreversible tissue necrosis is present despite normal ADC values
- DWI remains hyperintense due to T2 shine through

Chronic (>3 weeks)

- ADC signal high
- DWI signal low (as T2 hyperintensity and thus T2 shine through resolve)

Identify: Unenhanced CT Brain Axial view

Describe: Hypodensity in left occipital and parietal lobes. Sulcal effacement in this area but no midline shift

Diagnosis: Left Posterior cerebral artery (PCA) infarct

What next:

CT angiography (CTA)

CT perfusion Imaging

Normal perfusion parameters are:

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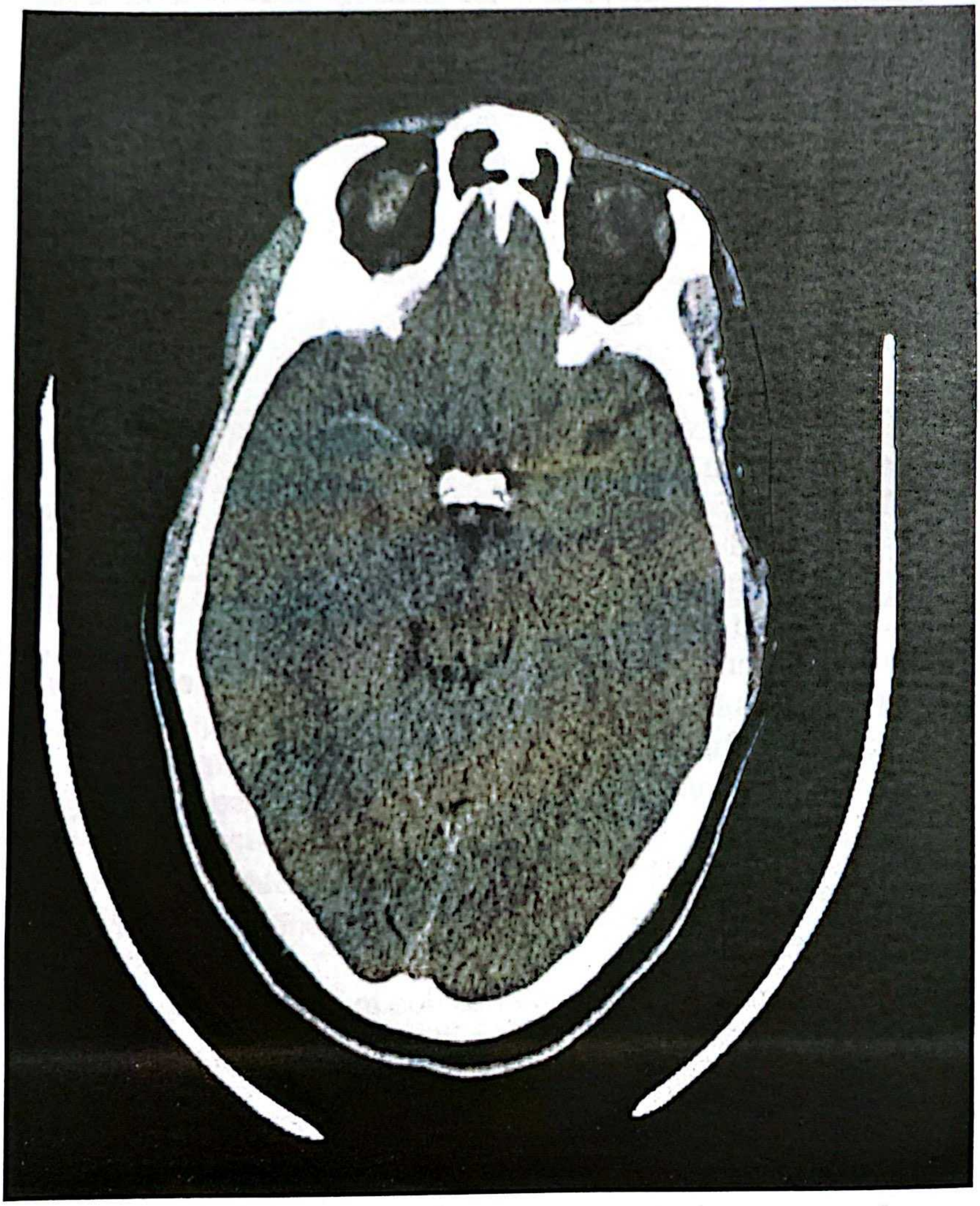
Q.6) Left hemiplegia-Elderly (2016), (2015)



Identify: Unenhanced CT Brain Axial view

Describe: The right middle cerebral artery is hyperdense and there is loss of normal grey white matter differentiation in the MCA territory.

There is subtle blurring, decreased attenuation and swelling of the grey-white matter junction of affected regions.

Loss of normal grey-white differentiation-insular ribbon sign
Diagnosis: Middle cerebral artery (MCA) territory acute infarction
What next: CT angiography (CTA)
CT perfusion Imaging
Normal perfusion parameters are:

Gray matter

- MTT: 4 s
- CBF: 60 ml/100 g/min
- CBV: 4 ml/100 g

White matter

- MTT: 4.8 s
- CBF: 25 ml/100 g/min
- CBV: 2 ml/100 g

FLAIR MRI
Diffusion weighted imaging (DWI)
The appearance of DWI/ADC depends on the timing.

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- ADC value decreases with maximal signal reduction at 1 to 4 days
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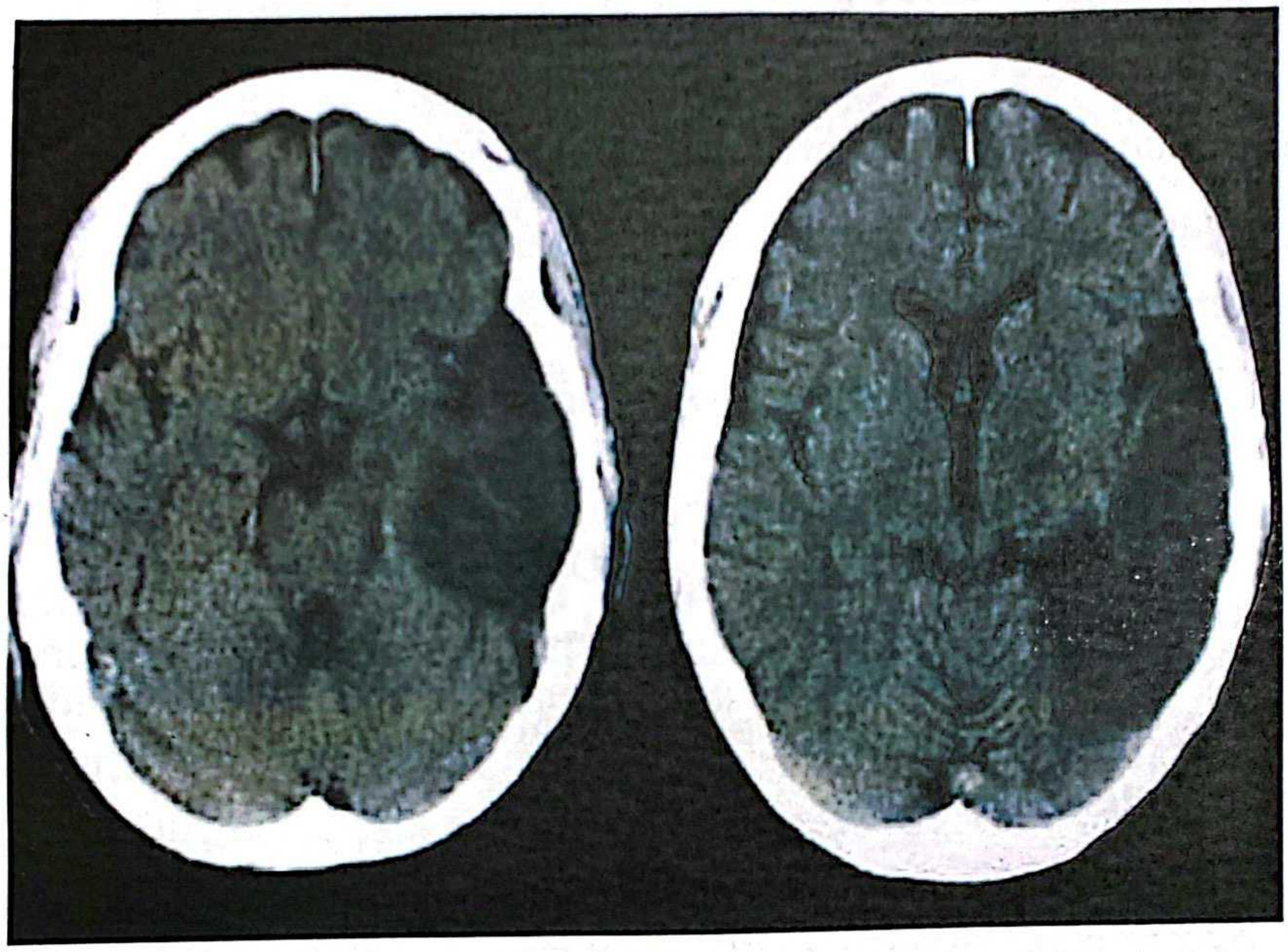
- ADC values to rise and return to near baseline
- irreversible tissue necrosis is present despite normal ADC values
- DWI remains hyperintense due to T2 shine through

Chronic (>3 weeks)

- ADC signal high
- DWI signal low (as T2 hyperintensity and thus T2 shine through resolve)
-

Treatment: Decompressive craniectomy is advocated by many as a life-saving procedure.

Q.7) **(2014)**



Identify: Unenhanced CT Brain Axial view

Describe: Hypodense area seen in the left fronto-temporal lobes with loss of gray white matter differentiation and effacement of cortical sulci and there is loss of normal grey white matter differentiation-insular ribbon sign

There is subtle blurring, decreased attenuation and swelling of the grey-white matter junction of affected regions.

No hemorrhage or midline shift. No hydrocephalus. Bone is unremarkable.

Diagnosis: Acute infarctions left Anterior cerebral artery (ACA) and Middle cerebral artery (MCA) territories

What next: CT angiography (CTA)

CT perfusion Imaging

Normal perfusion parameters are:

Gray matter

- MTT: 4 s
- CBF: 60 ml/100 g/min
- CBV: 4 ml/100 g

White matter

- MTT: 4.8 s

- CBF: 25 ml/100 g/min
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FLAIR MRI

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Chronic (>3 weeks)

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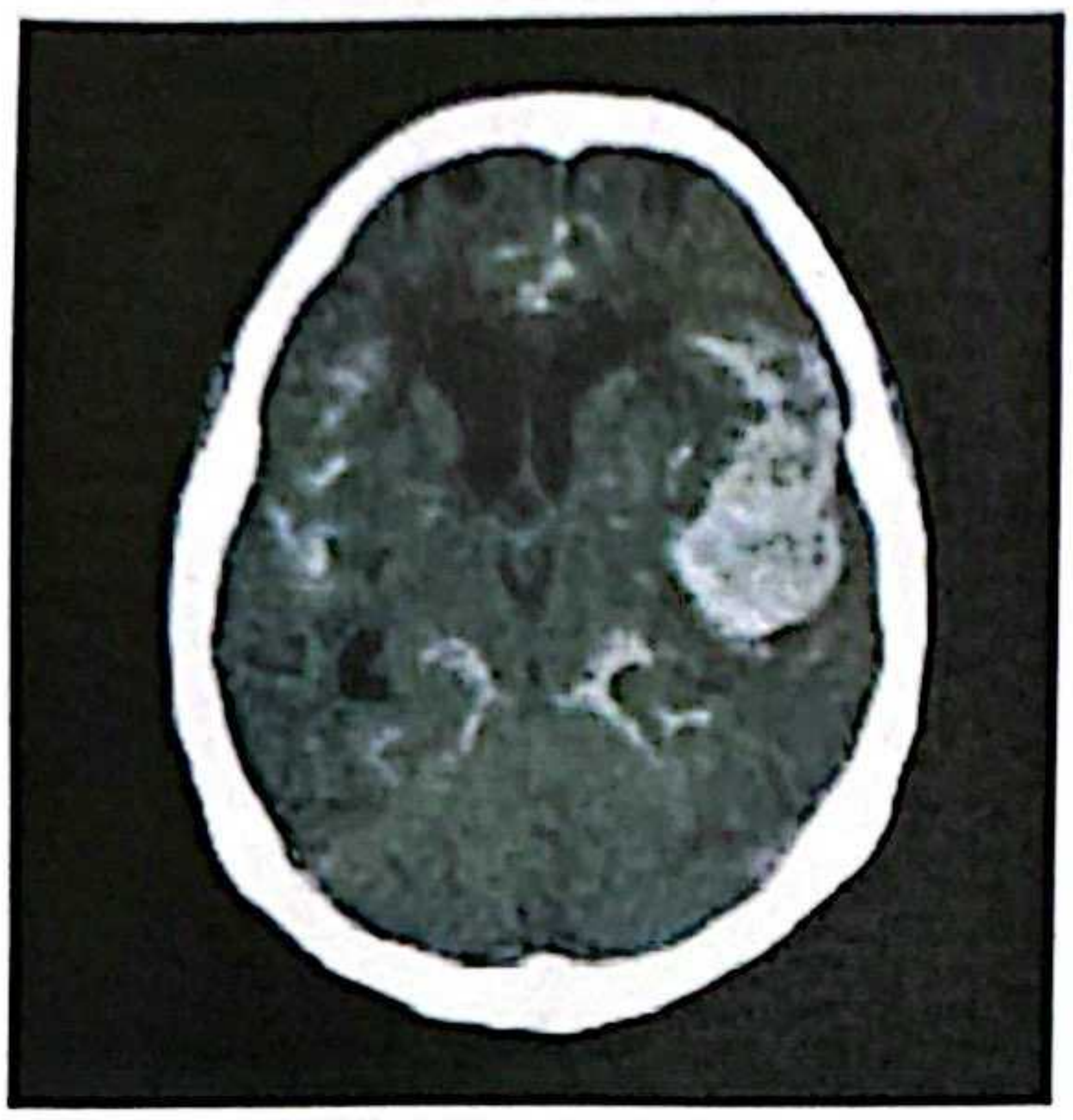
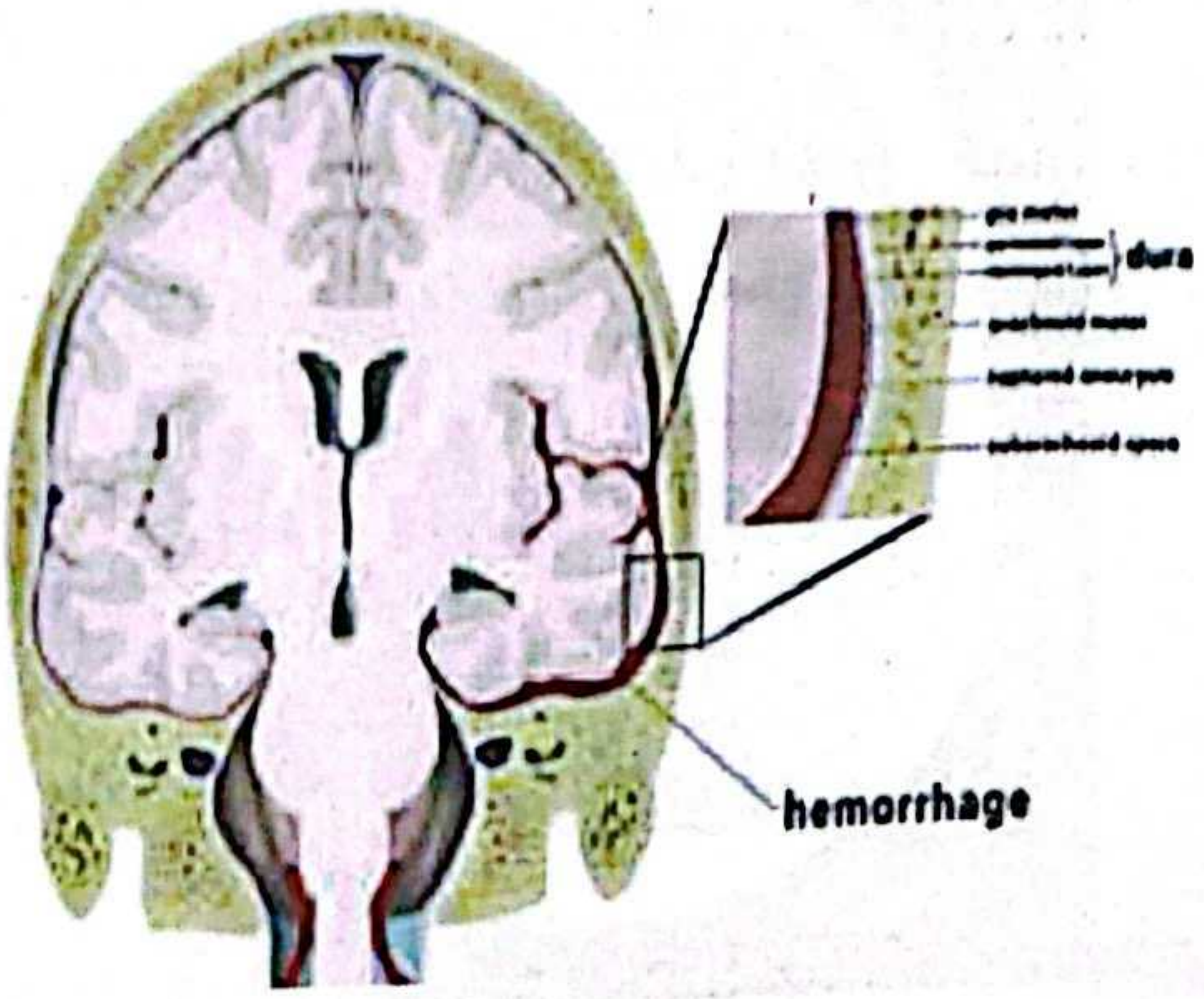
- DWI signal low (as T2 hyperintensity and thus T2 shine through resolve)
-

Treatment: Decompressive craniectomy is advocated by many as a life-saving procedure.

Q.8) Worst Headache of Life. 54Y-Female

(2017), (2018)





Identify: Unenhanced CT Brain Axial view

Describe: CT shows a large hyperdense lesion in the left temporal lobe having significant mass effect and midline shift. Posterior fossa unaltered

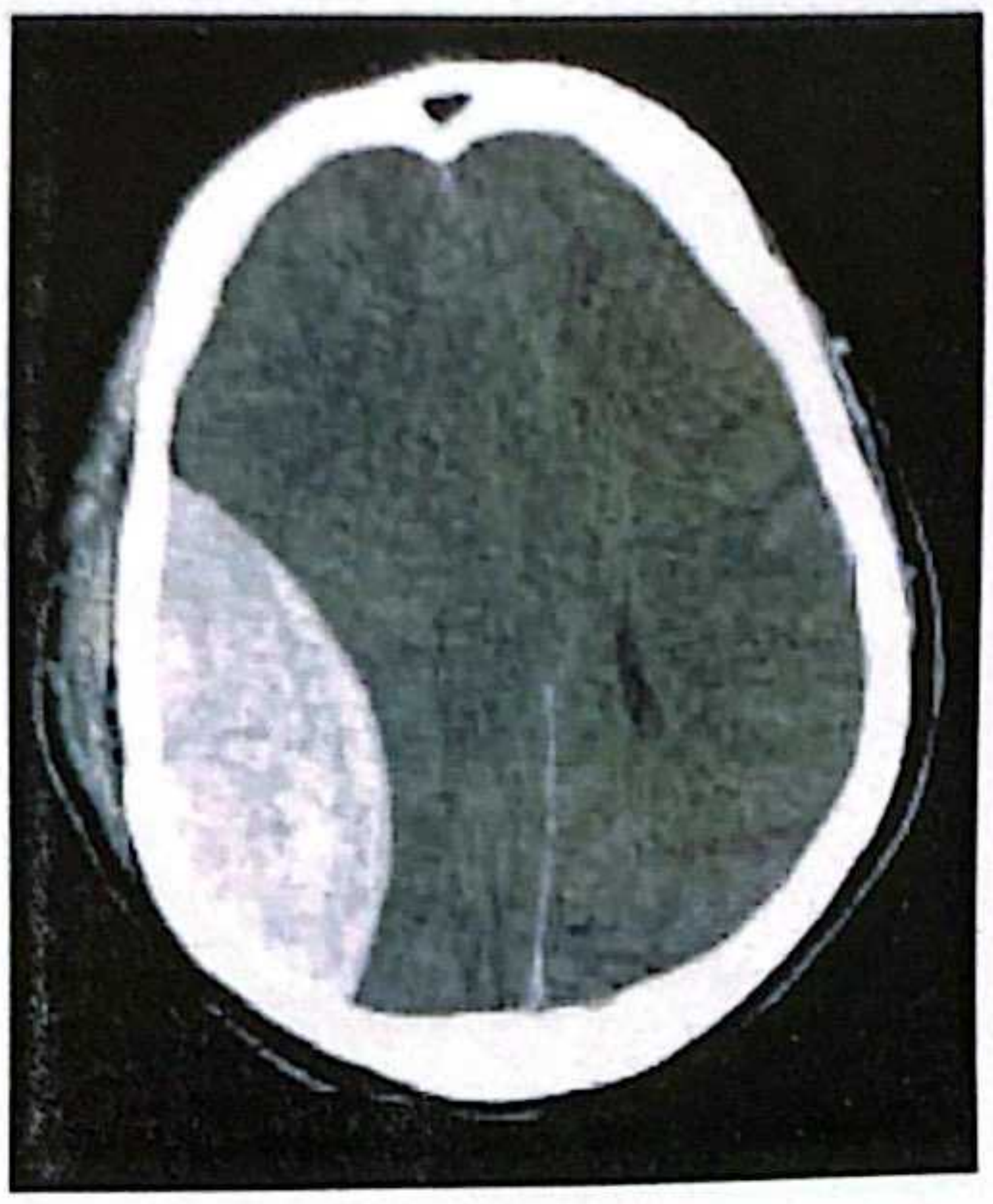
Diagnosis: Large intracranial hemorrhage suggestive of subarachnoid hemorrhage

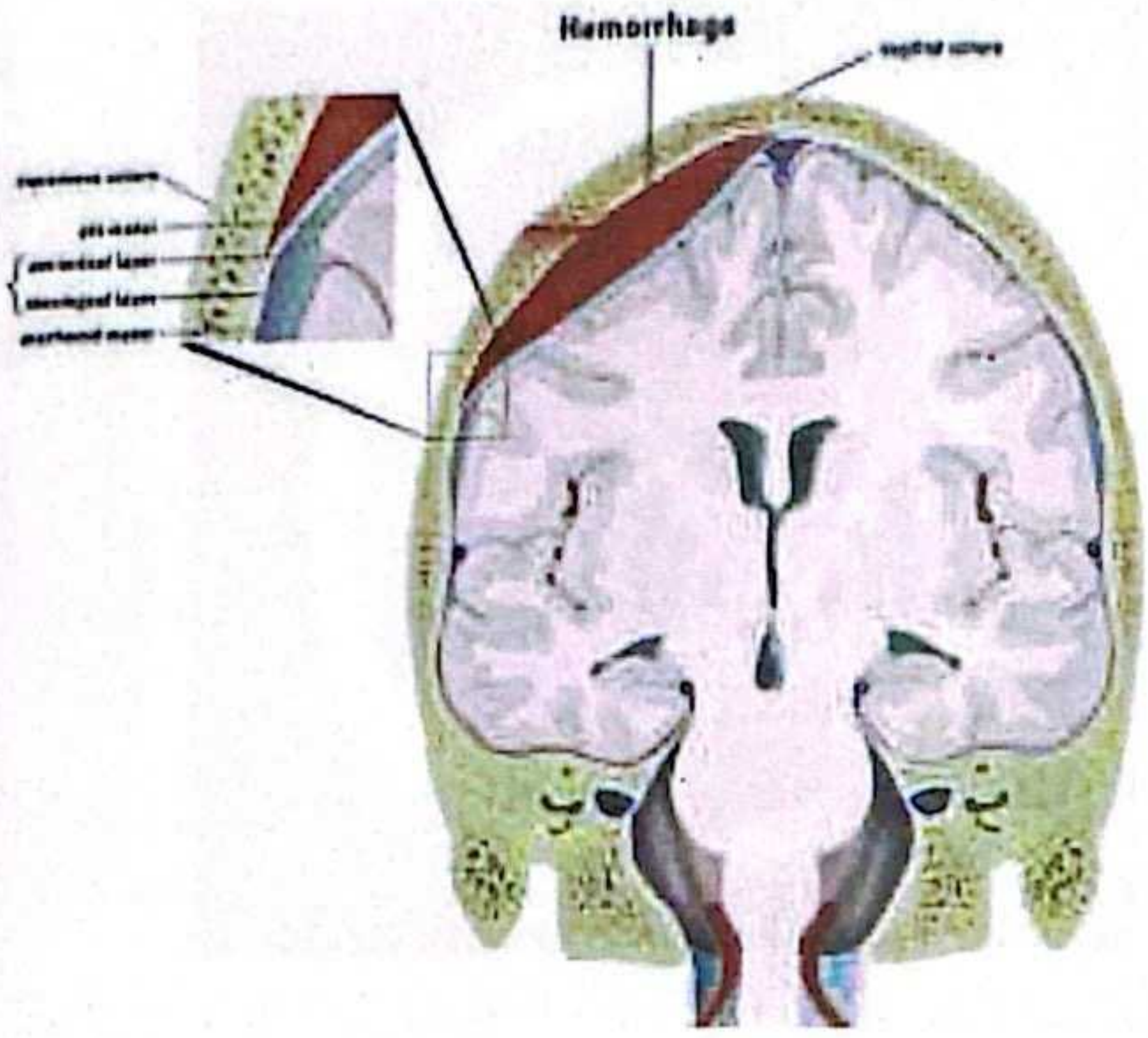
What next:

- MRI is sensitive to subarachnoid blood and is able to visualise it well in the first 12 hours typically as a hyperintensity in the subarachnoid space on FLAIR.
- Susceptibility weighted sequences are also exquisitely sensitive to blood products.
- MR angiography
- MR venography
- DSA: angiography: Digital subtraction catheter angiography remains the gold standard for diagnosis and characterisation of vascular abnormalities and in many centres, even if the causative lesion is identified on MRA or CTA and it is thought to require surgical management, a catheter study is carried out.

Q.9) Spot Diagnosis

(2016)

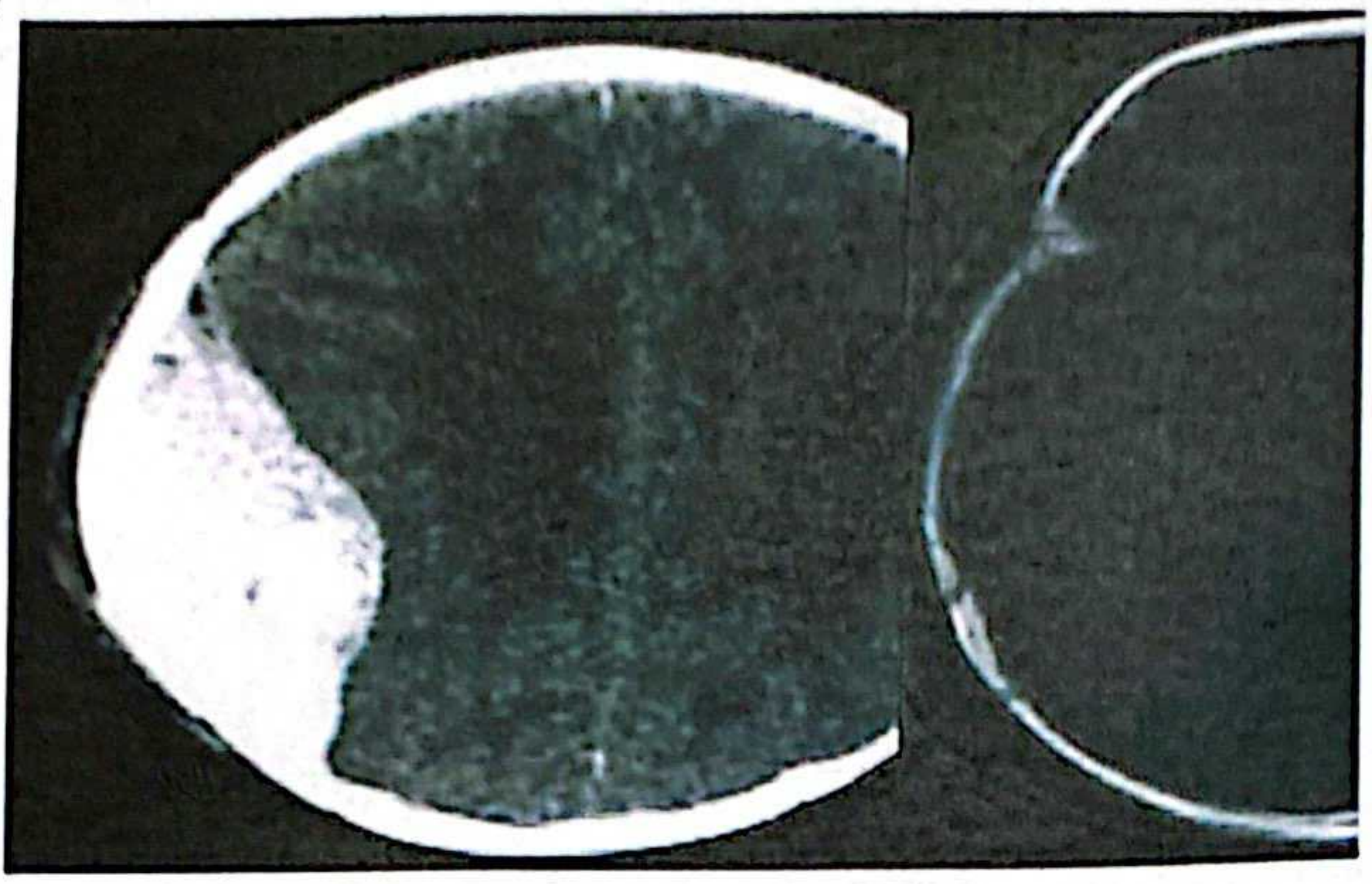




Identify: Unenhanced CT Brain Axial view
Describe: Extra-axial biconvex hyperdense collection in the right parieto-occipital lobes
Diagnosis: Extradural Hematoma
What next:

- MRI can clearly demonstrate the displaced dura that appears as a hypointense line on T1 and T2nsequences which is helpful in distinguishing it from a subdural haematoma.
- Acute EDH appears isointense on T1 and shows variable intensities from hypo- to hyperintense on a T2 sequence. Early subacute EDH appears hypointense on T2 while late subacute and chronic EDH are hyperintense on both T1 and T2 sequences.
- Intravenous contrast may demonstrate displaced or occluded venous sinus in case of venous origin of EDH.
- Angiography: It can be used to evaluate nontraumatic cause (i.e. AVM) of EDH. Rarely angiography can demonstrate middle meningeal artery laceration and contrast extravasation from middle meningeal artery into paired middle meningeal veins known as "tram track sign".

Q.10) **(2014)**



Identify: CT brain non-contrast study brain and bone windows axial images.

Describe: Right temporo-parietal epidural hematoma causing mass effect on the temporal and parietal lobe, midline shift the left, compression of the right lateral ventricle and right uncal herniation.
Multiple air specks in the epidural hematoma: pneumocephalus.
Linear non-displaced fracture of the right squamous temporal bone.
Right temporoparietal scalp swelling.

Diagnosis: Epidural/extradural hematoma with rupture of middle meningeal artery.

What next:

- **MRI** can clearly demonstrate the displaced dura that appears as a hypointense line on T1 and T2nsequences which is helpful in distinguishing it from a subdural haematoma.
- Acute EDH appears isointense on T1 and shows variable intensities from hypo- to hyperintense on a T2 sequence. Early subacute EDH appears hypointense on T2 while late subacute and chronic EDH are hyperintense on both T1 and T2 sequences.
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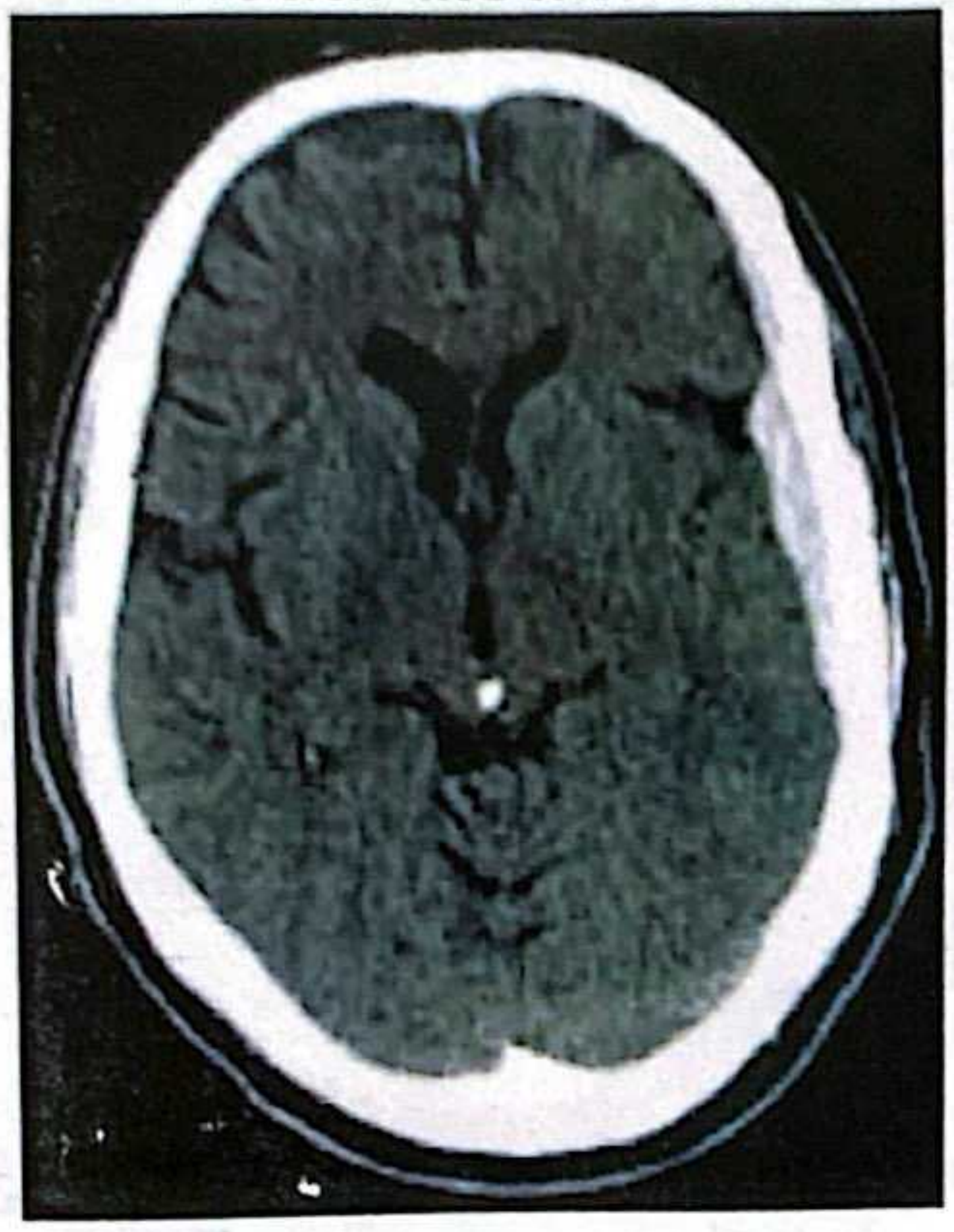
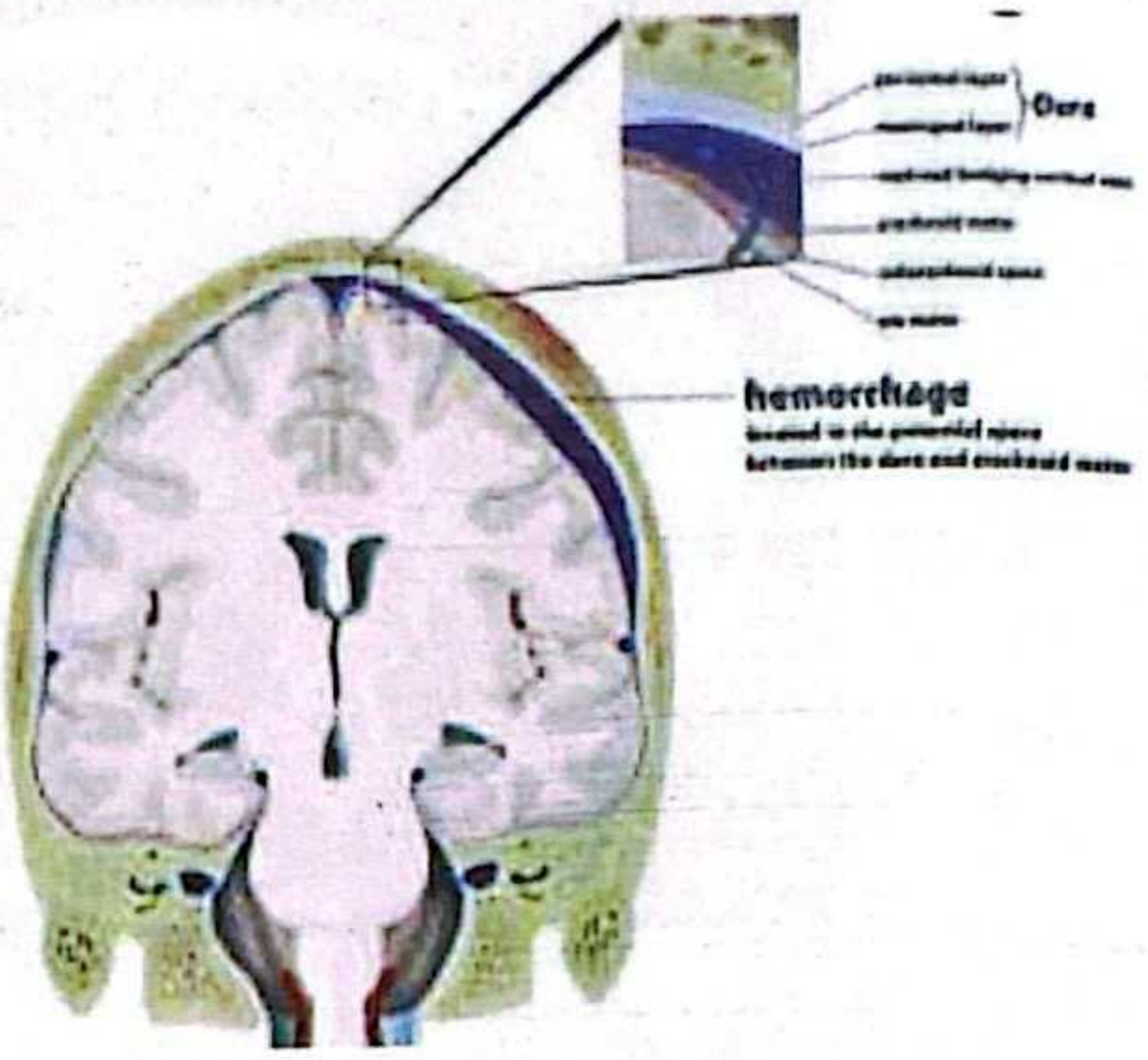
Q.11) Struck head two days ago with increasing headache and visual disturbance. 60Y-Male (2015)





Identify: Unenhanced CT Brain Axial view

Describe: A crescentic hyperdense extra-axial collection spread diffusely over the left hemisphere extending down to the left temporal lobe in keeping with a moderate size acute left subdural hemorrhage. There is associated effacement of sulci and mass effect of the left lateral ventricle resulting in minimal (2 mm) rightward midline shift. The CSF containing spaces are normal without any evidence of hydrocephalus

Diagnosis: Subdural hematoma

What next:

The appearance of SDHs on CT varies with clot age and organisation.

Hyperacute

In most instances, patients are not imaged in the hyperacute phase (first hour or so), but on occasion when this is performed they appear relatively isodense to the adjacent cortex, with a swirled appearance due to a mixture of clot, serum and ongoing unclotted blood. There is often a degree of underlying cerebral swelling (especially in young patients where head trauma is often more severe) which accentuates the mass-effect created by the collection.

Acute

The classic appearance of an acute subdural haematoma is a crescent-shaped homogeneously hyperdense extra-axial collection that spreads diffusely over the affected hemisphere. As the clot starts to retract the density increases typically to >50-60 HU and is thus hyperdense relative to the cortex.

Up to 40% of SDHs have mixed hyper- or hypodense areas that reflect unclotted blood, serum extruded during clot retraction or CSF within the subdural haematoma due to an arachnoid laceration.

Rarely, acute SDHs may be nearly isodense with the adjacent cerebral cortex. This occurs with anticoagulation, coagulopathies or severe anaemia when the haemoglobin concentration drops to 8 to 10 g/dl. Patients with a deficient coagulation can also demonstrate a hematocrit fluid-fluid level as the blood does not form a clot and red cells have time to drift dependently.

In patients with underlying low haemoglobin and platelets conditions such as sickle cell anaemia, acute subdural haemorrhage may be hypodense even in the acute phase.

Subacute

As the clot ages and protein degradation occurs, the density starts to drop. At some point between 3 and 21 days (typically 10-14 days), the density will drop to ~ 35-40 HU and become isodense to the adjacent cortex, making identification potentially tricky, especially if subdural collections are bilateral 4. Contrast-enhanced CT is often useful in this instance if MRI is unavailable. The key to identification is visualising a number of indirect signs, including:

CSF-filled sulci do not reach the skull but rather fade out into the subdural mass-effect including sulcal effacement (distortion) and midline shift apparent thickening of the cortex

Chronic

By definition, it is at least 3 weeks old.

The subdural collection becomes hypodense and can reach 0HU and be isodense to CSF, and mimic a subdural hygroma. A crescentic shape may change to a biconvex one.

Acute on chronic

Acute on chronic subdural haematomas refers to a second episode of acute haemorrhage into a pre-existing chronic subdural haematoma. It typically appears as a hypodense collection with a haematocrit level (located posteriorly). A similar appearance can be seen in patients with clotting disorders or on anticoagulants.

Ageing blood on MRI (mnemonic)

I Bleed

- T1 Isointense
- T2 Bright

Hyperacute <24 hrs

- fresh oxygenated arterial blood contains 95% diamagnetic (= no unpaired electrons)
- intracellular oxyhemoglobin (Fe2+) with higher water contents than white matter;
- oxyhemoglobin persists for 6-12 hr
- homogeneous consolidated high-density lesion (50-70HU)

I Die

- T1 Isointense
- T2 Dark

Acute 1 to 3 days

- Intracellular deoxyhaemoglobin

Bleed Die

- T1 Bright
- T2 Dark

Early subacute 2 to 7 days

- Intracellular methaemoglobin

Bleed Bleed

- T1 Bright
- T2 Bright

Late subacute 7 to 14-28 days

- extracellular methaemoglobin: over the next few weeks, as cells break down, extracellular methaemoglobin leads to an increase in T2 signal

Die Die

- T1 Dark
- T2 Dark

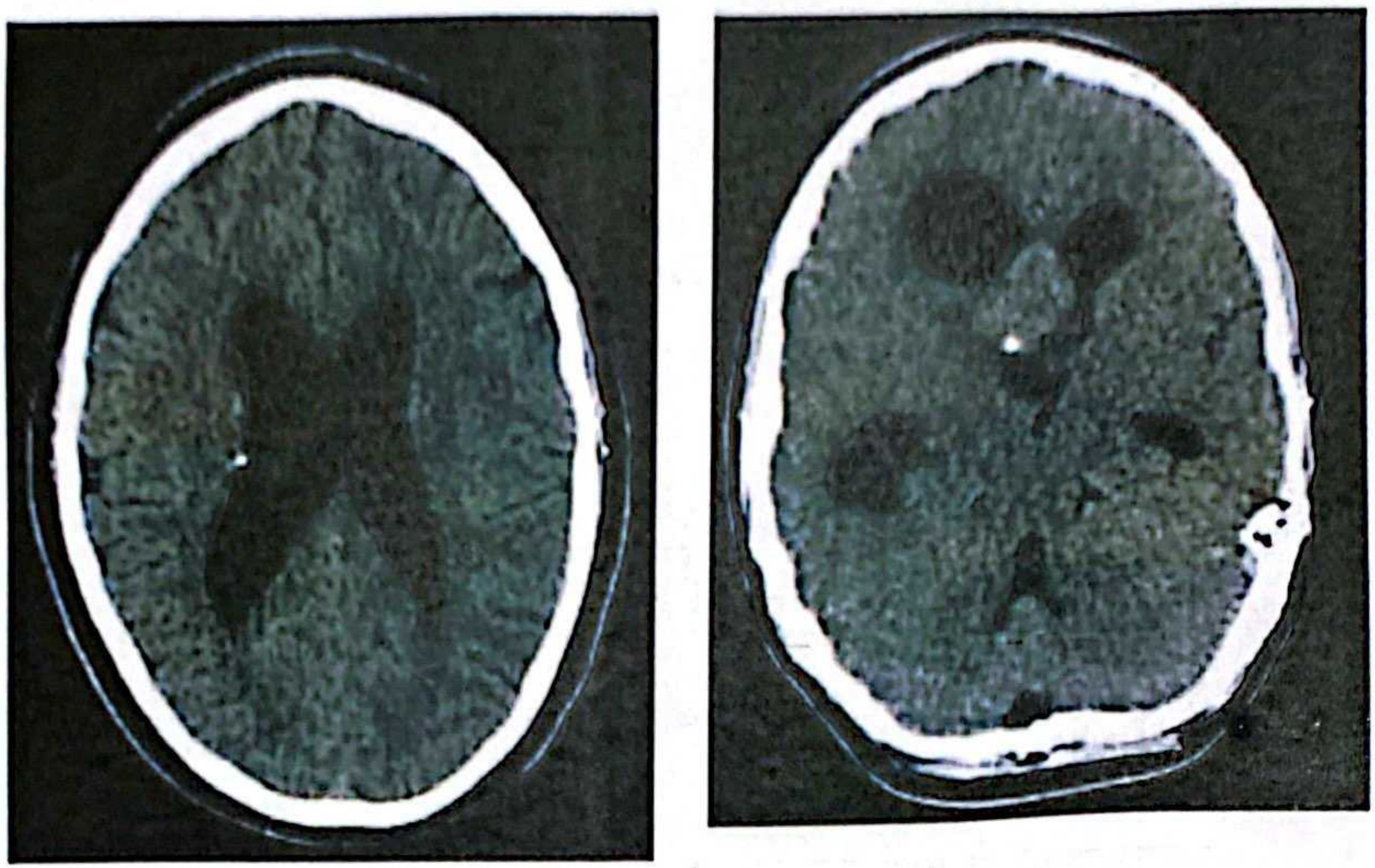
Chronic >14 to 28 days

- Periphery: intracellular haemosiderin
- Center: extracellular haemichromes

Practical points

- Extracranial blood products age differently from intracranial blood products, and extracranial haematomas often have a heterogeneous appearance, confounding attempts at reliably dating the age of an extracranial haemorrhage
- Blood/haemorrhage appears hypointense and blooms black on MRI T2*
- GRE imaging is also highly sensitive to old haemorrhage and is seen as haemosiderin staining

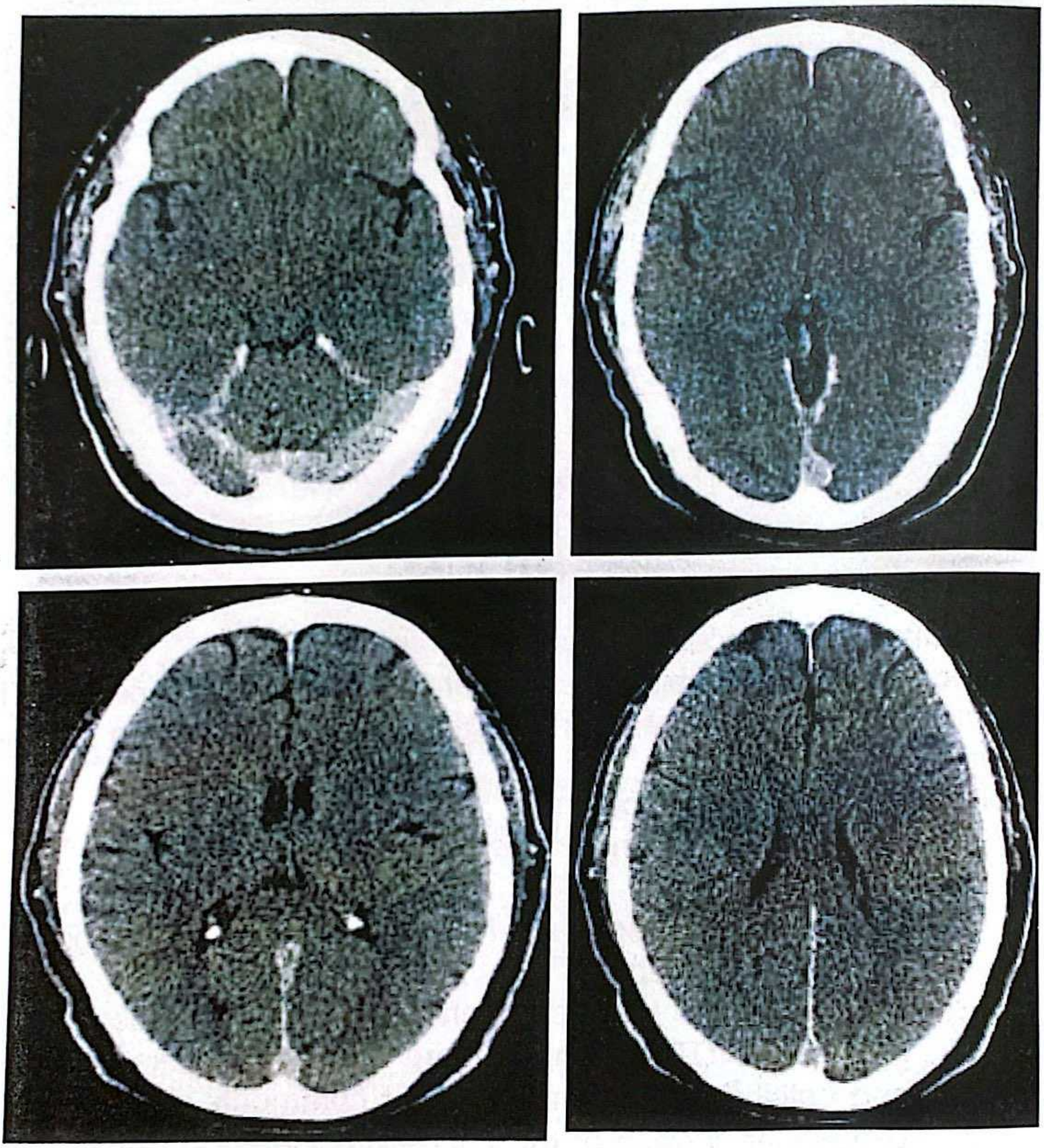
Q.12) **(2013)**



Identify: Unenhanced CT Brain Axial view
Describe: Calcified sub ependymal tubers, Calcified mass in the region of foramen of monro: giant cell astrocytoma & Mild hydrocephalus
Diagnosis: Tuberous sclerosis
What next: History & Clinical examination, MRI

1. Subependymal nodules / Subependymal hamartomas – "candle drippings" appearance---Multiple small subependymal lesions which calcify in 80%. Disorganized glial cells NOT heterotopic grey, which increase in number and calcification with time– most commonly seen along the ventricular surface of the caudate nucleus. **Variable signal, frequently high T1 and iso to high T2**
2. Cortical tubers / Parenchymal tubers which are non-enhancing and are usually multiple and can show rim calcification in 50%. 50% are in the frontal lobe; **high T2 and low T1 with only 10% of tubers showing enhancement.**
3. Giant cell astrocytoma – large glial nodules related to foramina of Monro and can cause hydrocephalus. Malignant potential is low & tend to have intense enhancement.
4. Transmantle white matter dysplasia--radial bands are thought to be relatively specific for TS– **high T2 signal on MRI.**

Q.13) **(2013).**



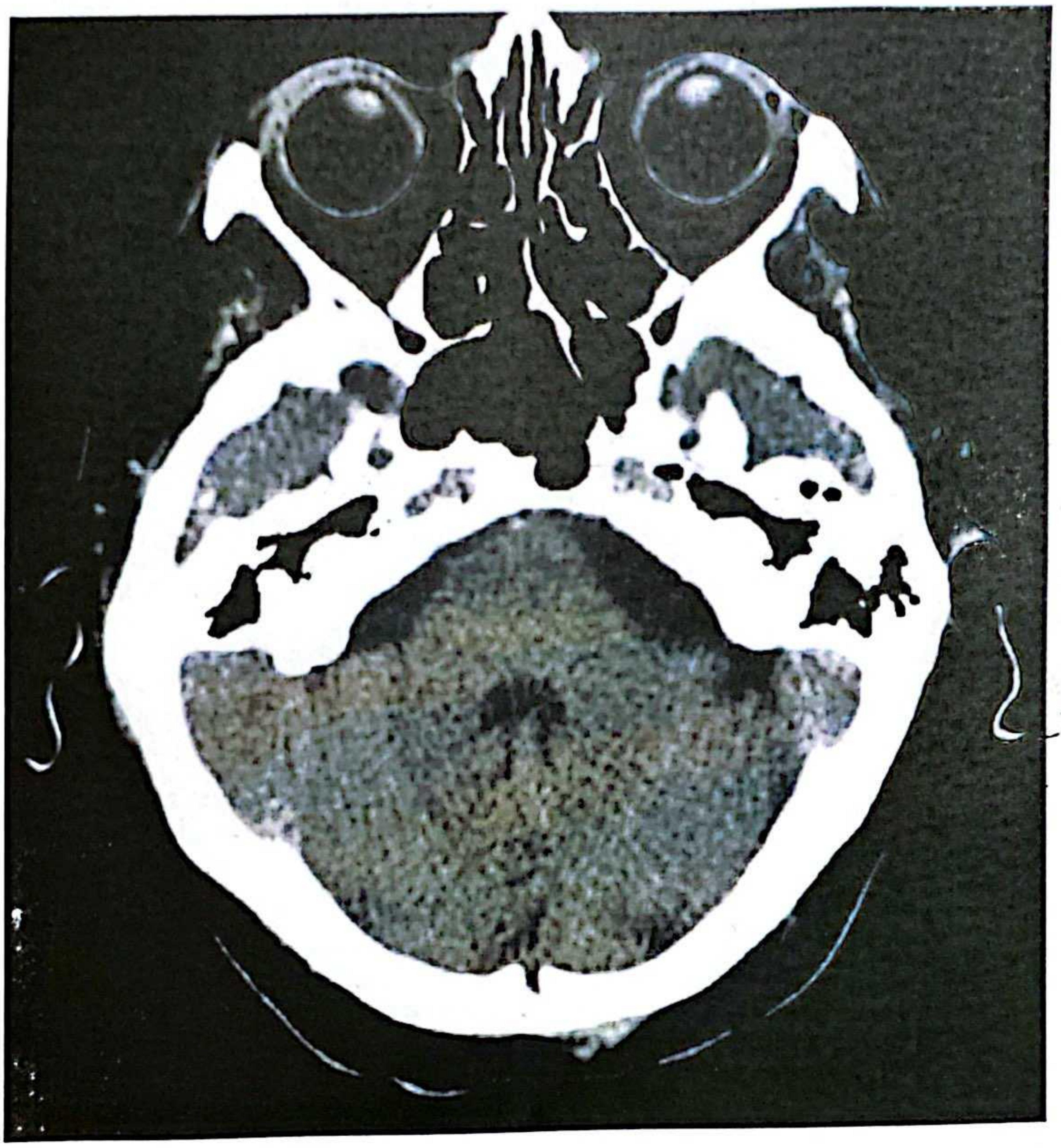
Identify: Unenhanced CT Brain Axial view

Describe: Thickened dense left transverse, straight and superior sagittal sinuses and torcula, Effaced sulci and ventricles showing cord sign & empty delta sign.

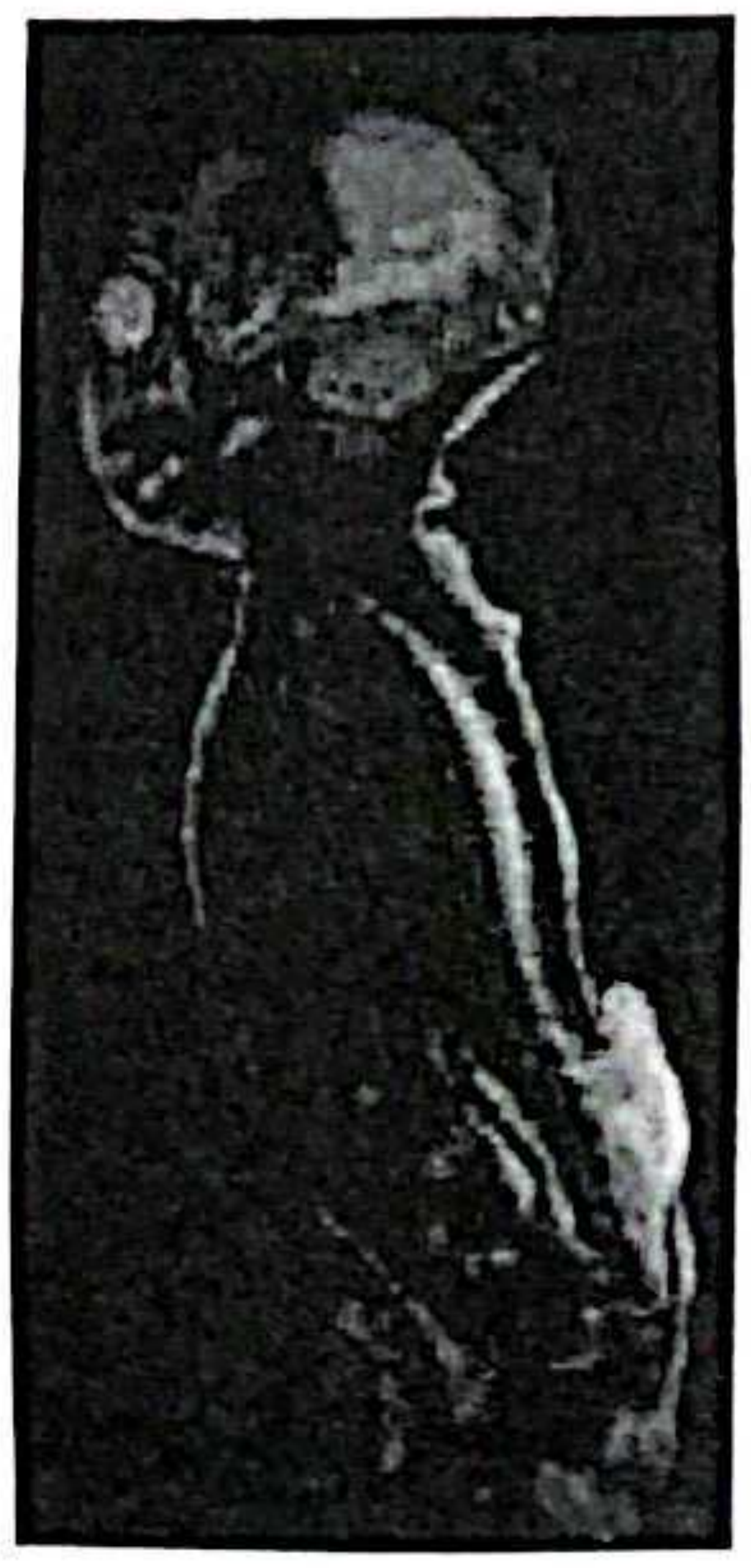
Diagnosis: Dural venous sinus thrombosis

What next: MRV Brain

Q.14) Chiari II Malformation (2012)



Small posterior fossa, defects of the septum pellucidum and corpus callosum, dysplasia of the skull vault.



Sagittal T2W images of brain and spine showing small posterior fossa, concavity of clivus, cerebellar tonsillar herniation, hydrocephalus and thinning of corpus callosum. Axial T2W images of the lumbosacral spine showing defect in the posterior elements with myelomeningocele.

MRI

MRI is the modality of choice for detecting and characterising the full constellation of findings associated with Chiari II malformations.

Posterior fossa

small posterior fossa with a low attachment of the tentorium and low torcula

the brainstem appears 'pulled' down with an elongated and low lying fourth ventricle

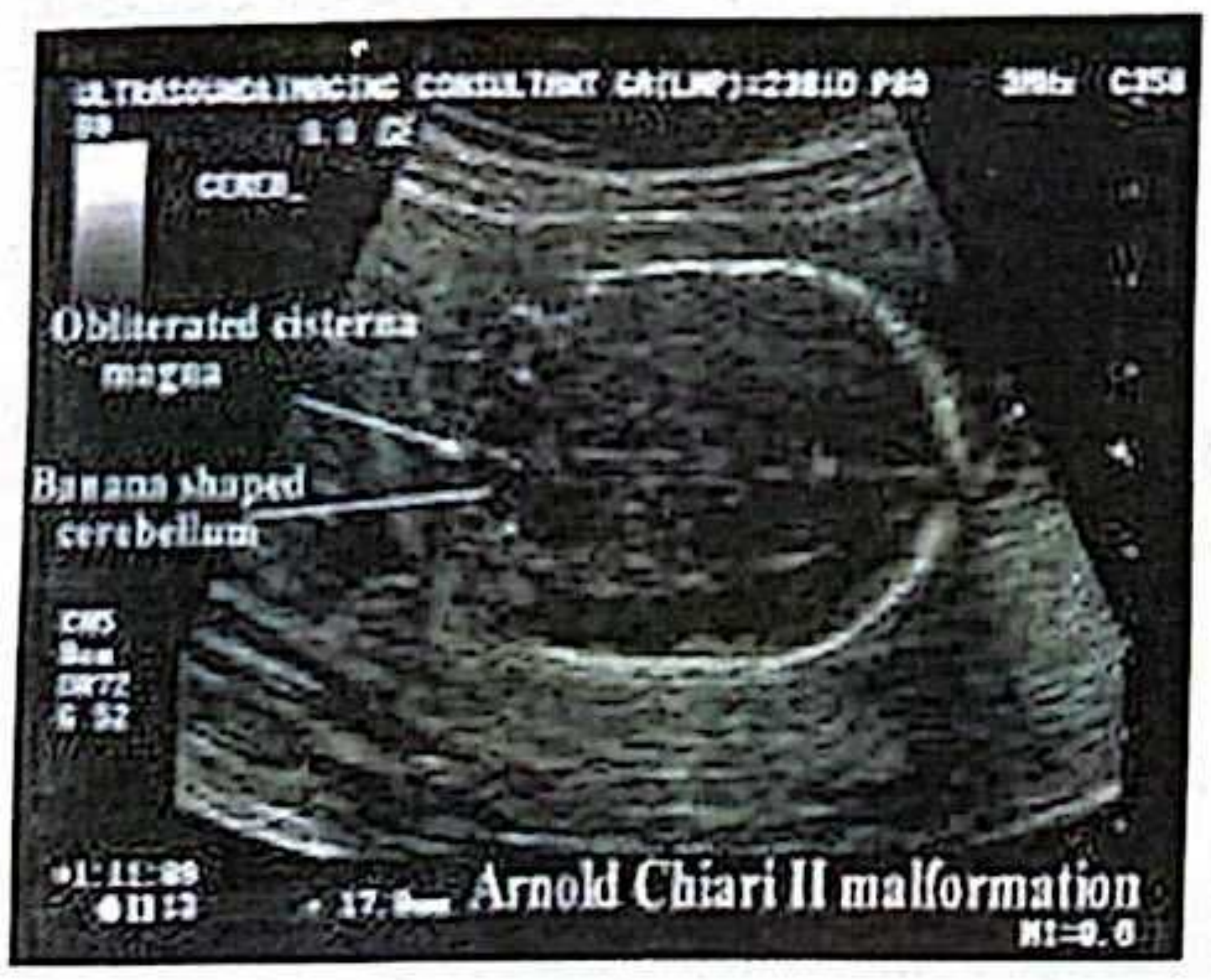
the tectal plate appears beaked: inferior colliculus is elongated and points posteriorly, with resulting angulation of the aqueduct which results in aqueductal stenosis and hydrocephalus

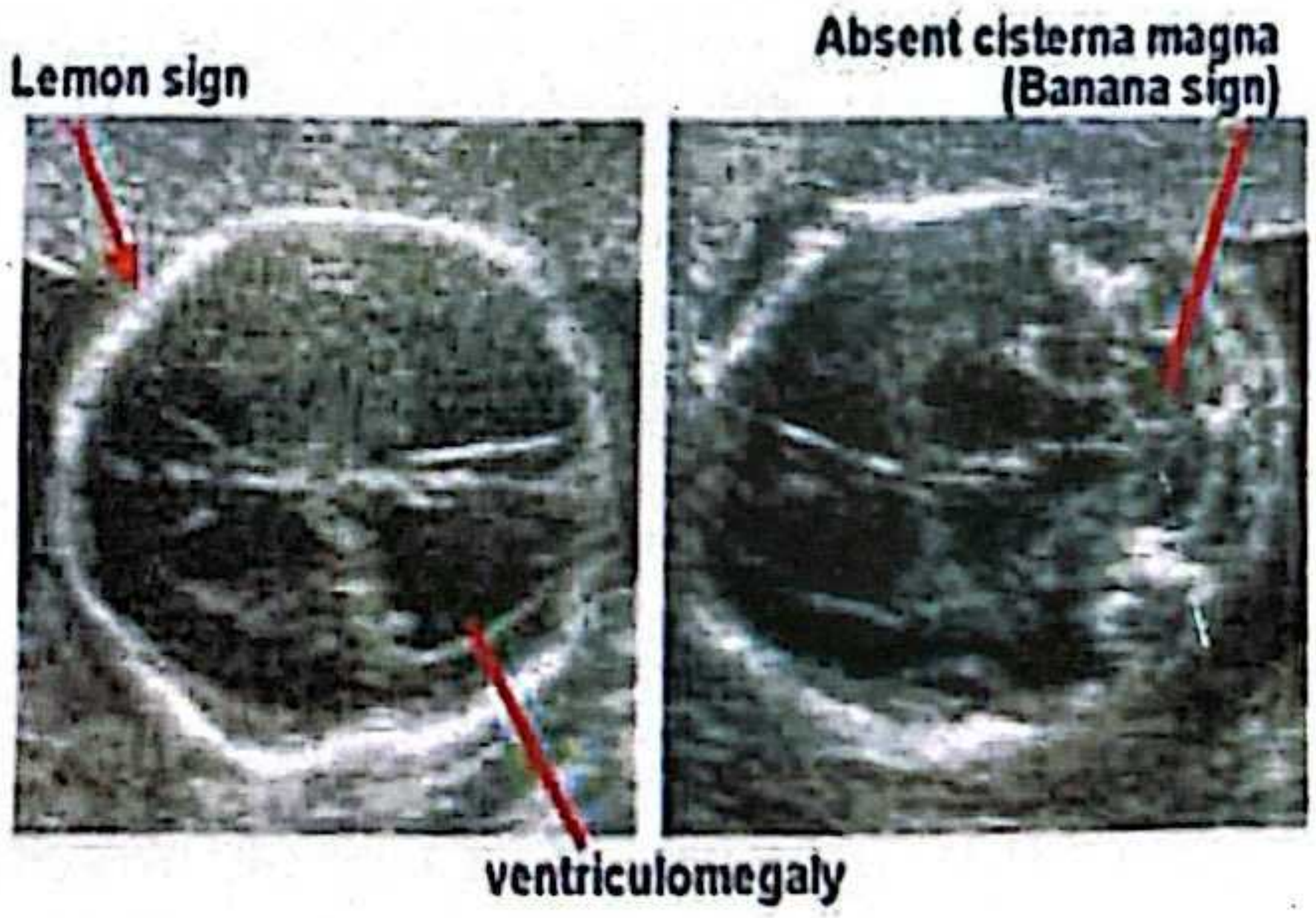
cerebellar tonsils and vermis are displaced inferiorly through foramen magnum which appears crowded

Spine

spina bifida aperta / myelomeningocoele

tethered cord

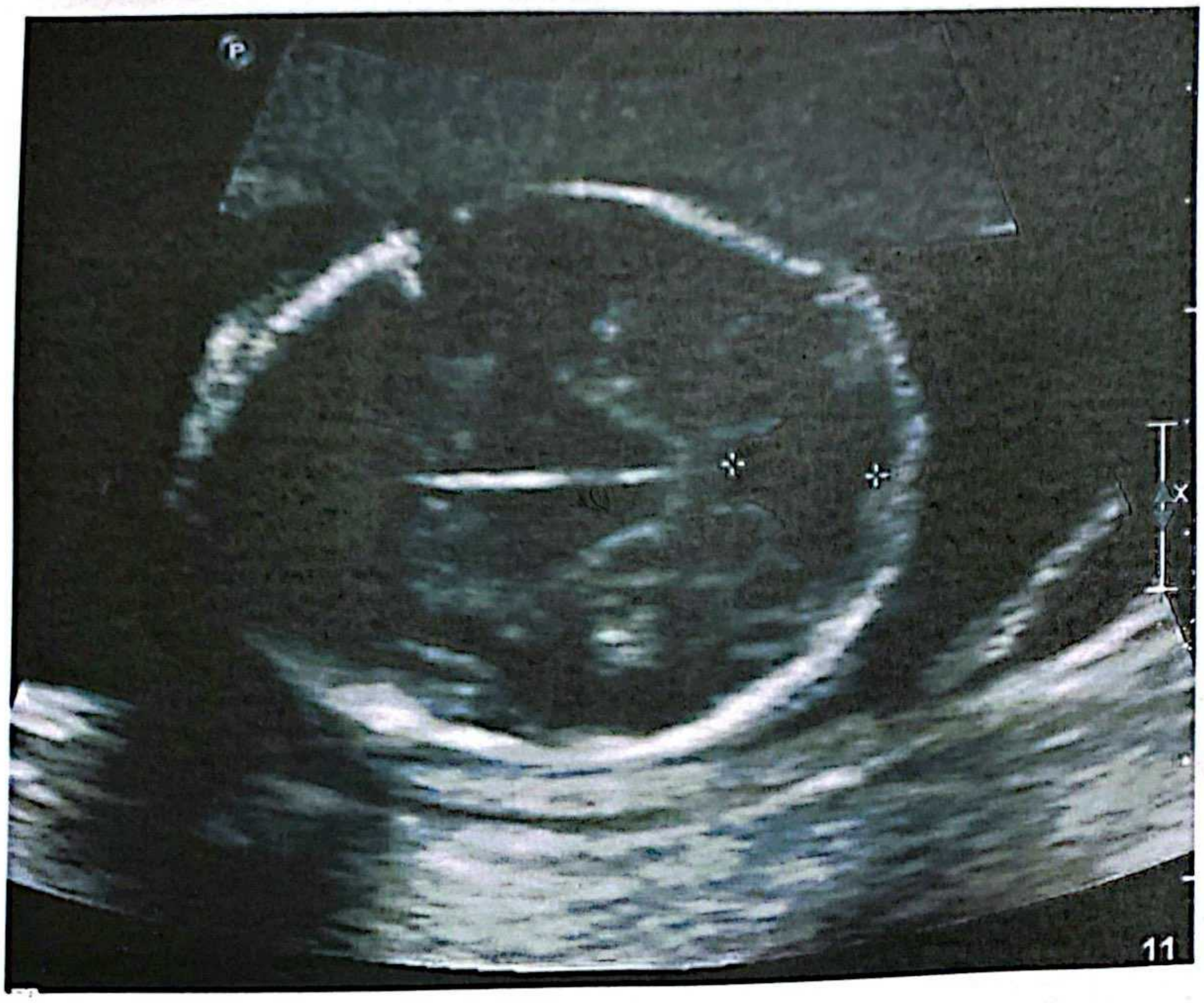

Obliterated cisterna magna
Banana shaped cerebellum
Arnold Chiari II malformation


Lemon sign
Absent cisterna magna (Banana sign)
ventriculomegaly

Antenatal ultrasound

- Classical signs described on ultrasound include
- Lemon sign
- Banana cerebellum sign
- There may also be evidence of fetal ventriculomegaly due to obstructive effects because of downward cerebellar herniation. Additionally, many of the associated malformations (e.g. corpus callosal dysgenesis) may be identified.

Q.15) Dandy-Walker malformation (2016)



Increased size of enlarged cisterna magna (CSF retrocerebellar space), due to complete vermian aplasia. There is also orbital hypertelorism. No other significant finding was detected.

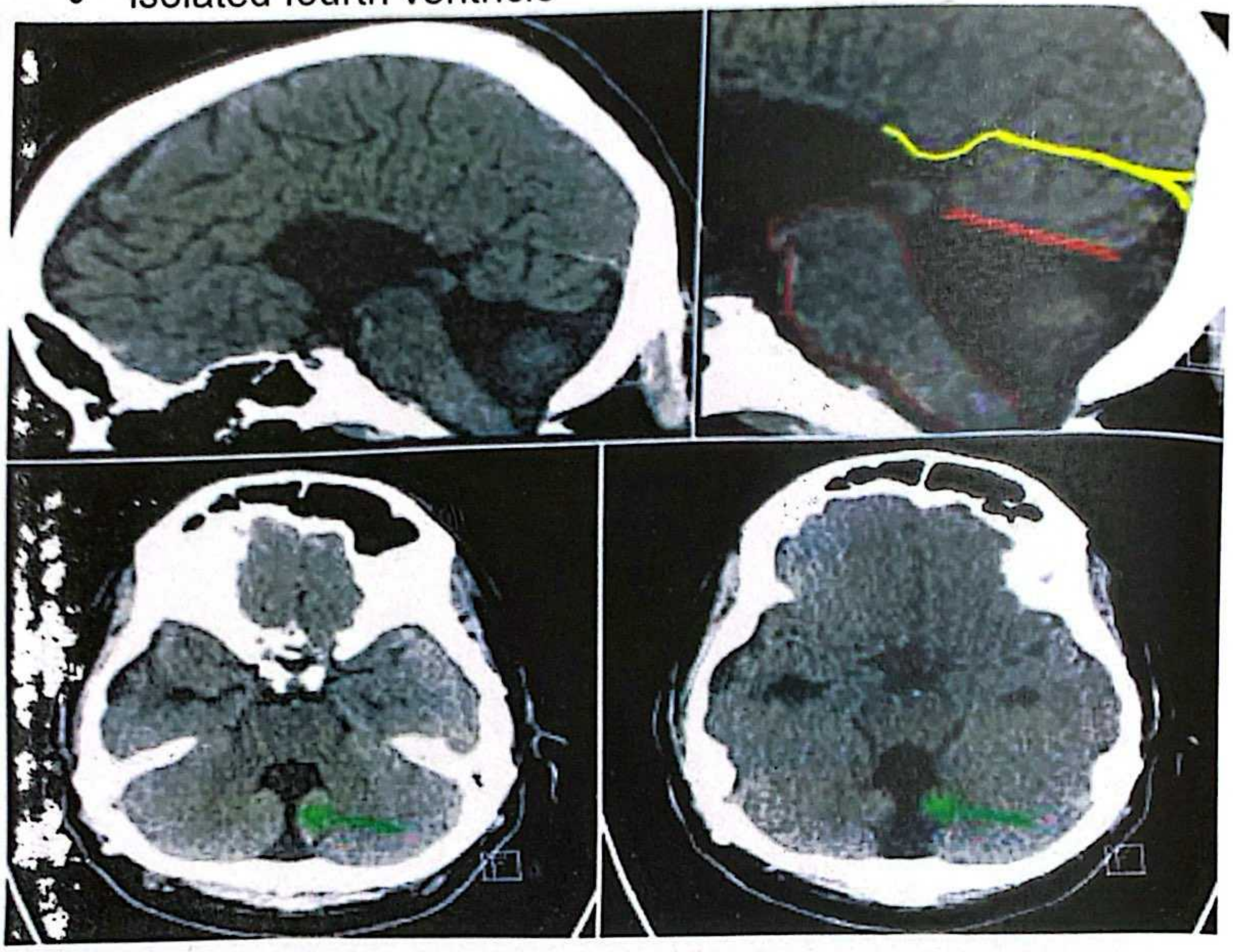
Ultrasound

- Antenatal sonographic features that would suggest the diagnosis include the combination of 9:
- marked enlargement of the cisterna magna (≥10 mm)
- complete aplasia of the vermis
- a trapezoid-shaped gap between the cerebellar hemispheres
- Antenatal ultrasound may falsely overdiagnose the condition if scanned before 18 weeks due to the vermis not being properly formed before that time.

Differential diagnosis

- megacisterna magna
- epidermoid cyst
- arachnoid cyst
- Blake pouch cyst
- Joubert anomaly (vermian hypoplasia)

- isolated fourth ventricle



MRI

MRI is the modality of choice for assessment of Dandy-Walker malformation, although both CT and ultrasound will demonstrate the pertinent features.

Classically Dandy-Walker malformation consists of the triad of:

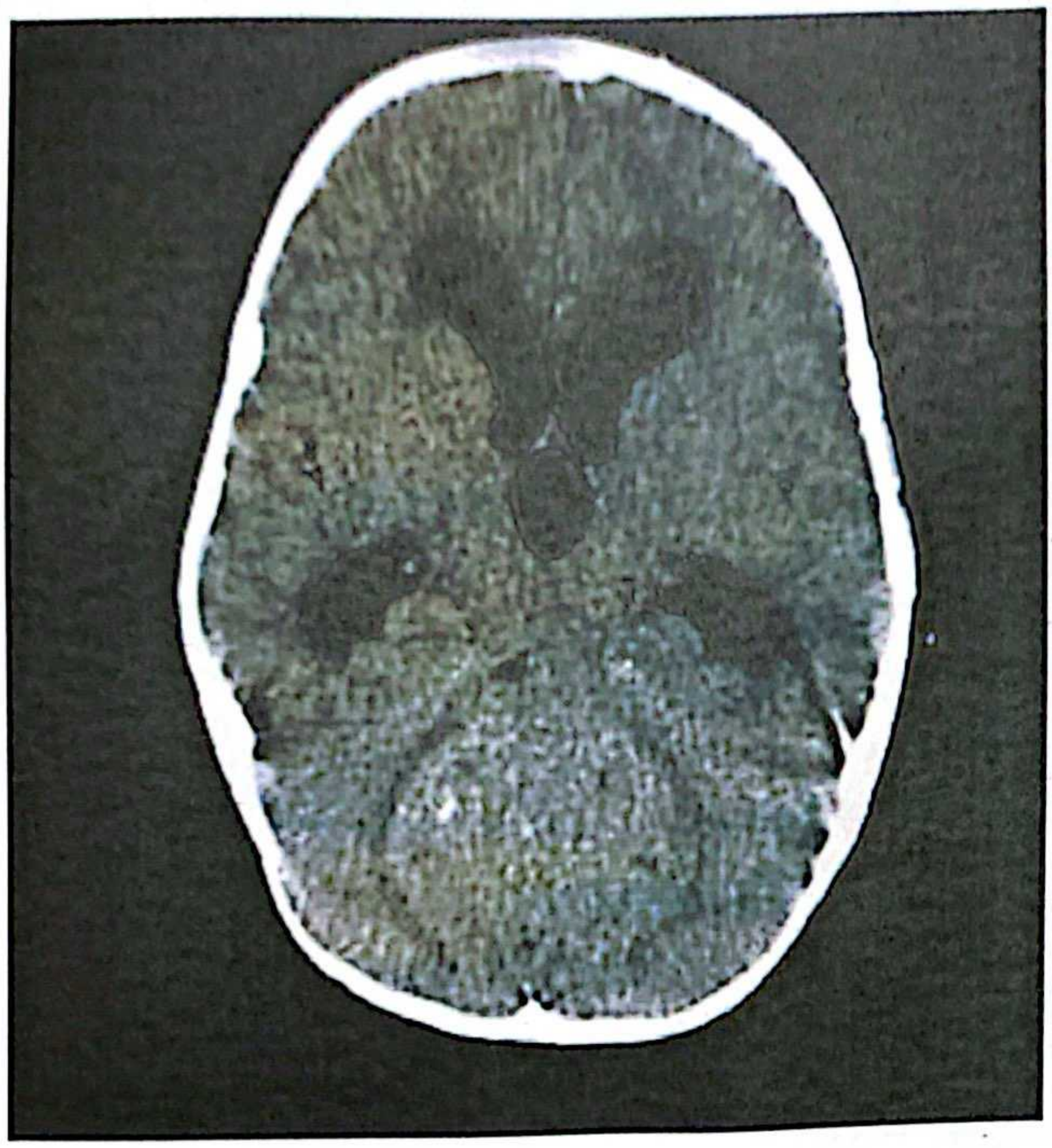
hypoplasia of the vermis and cephalad rotation of the vermian remnant

cystic dilatation of the fourth ventricle extending posteriorly; usually the cerebellar hemispheres are displaced anterolaterally, but with a normal size and morphology

enlarged posterior fossa with torcular-lambdoid inversion (torcular lying above the level of the lambdoid due to abnormally high tentorium)

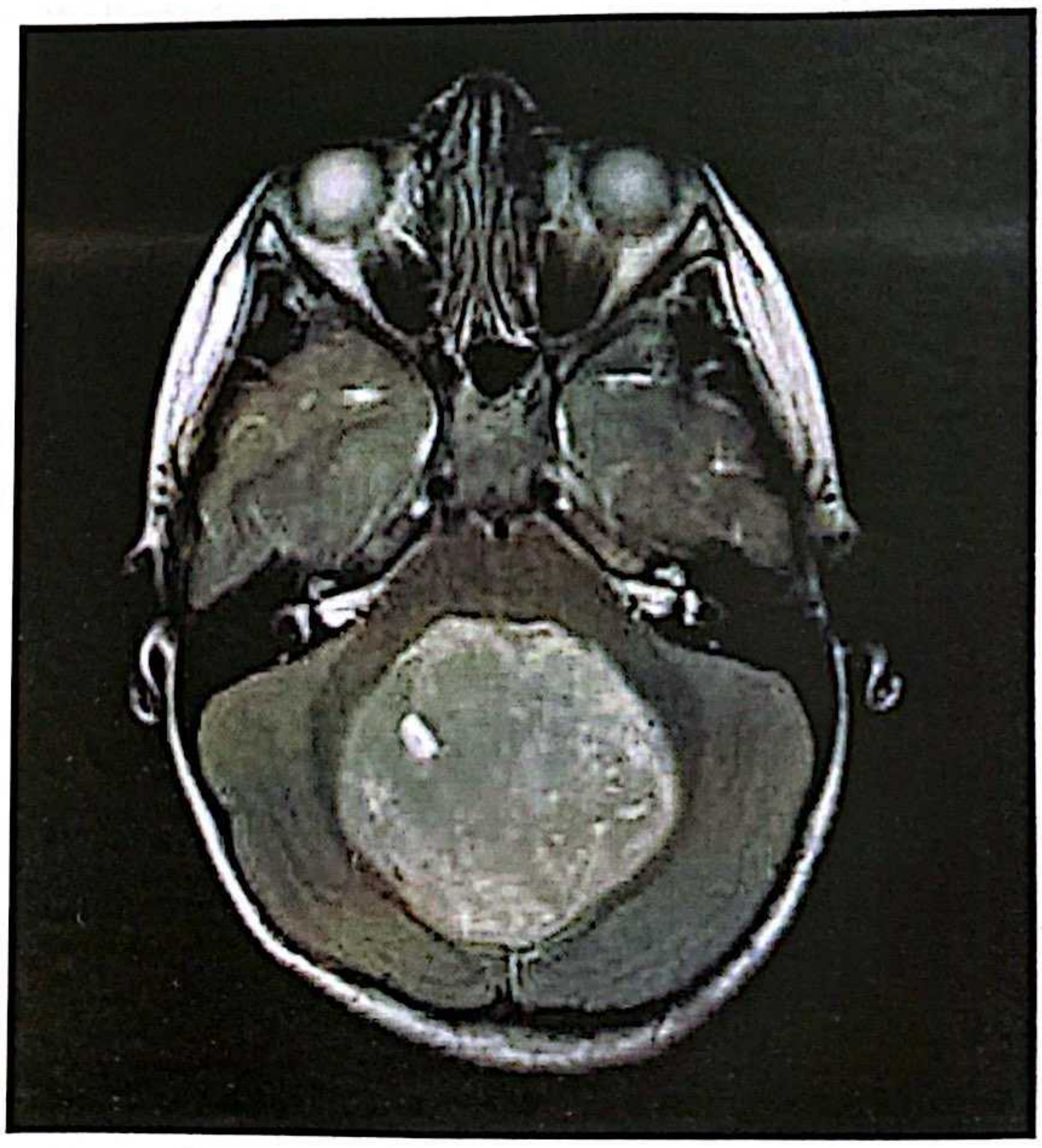
In 75-90% of patients, an obstructive hydrocephalus is evident by three months of age in many cases due to aqueduct stenosis. CSF flow study is recommended to better assess the hydrodynamic changes and identify eventual aqueductal stenosis association, which can not be treated by cystoperitoneal shunt placement

Q.16) Medulloblastoma (2014)



Very large mass located centrally within the posterior fossa. It is slightly hyperdense on CT.

As a result of the mass effect on the fourth ventricle, significant obstructive hydrocephalus has developed, with transependymal oedema noted particularly at the frontal and occipital horns.



Very large mass located centrally within the posterior fossa. It is high T2 signal and low T1 signal with only patchy contrast enhancement.

No normal vermis can be identified and the mass is likely to arise from it, completely effacing the fourth ventricle and abutting the dorsal aspect of the brainstem without convincing evidence of extension into the pons.

As a result of the mass effect on the fourth ventricle, significant obstructive hydrocephalus has developed, with transependymal oedema noted particularly at the frontal and occipital horns.

MRI

T1

- hypointense to grey matter

T1 C+ (Gd)

- overall 90% enhance, often heterogeneously
- group 4 tumours tend to enhance less

T2/FLAIR

- overall are iso to hyperintense to grey matter
- heterogeneous due to calcification, necrosis and cyst formation
- surrounding oedema is common

DWI/ADC

- high DWI signal ("restricted diffusion")
- low ADC values (lower than normal cerebellum)

MR spectroscopy

- elevated choline
- decreased NAA
- may show a taurine peak

Differential diagnosis

In the paediatric population consider:

- ependymoma:
- usually arises from the floor of the 4th ventricle
- typically squeezes out the foramen of Luschka
- choroid plexus papilloma (CPP) : more common in lateral ventricles in children
- pilocytic astrocytoma
- atypical teratoid/rhabdoid tumour
- brainstem glioma (exophytic)

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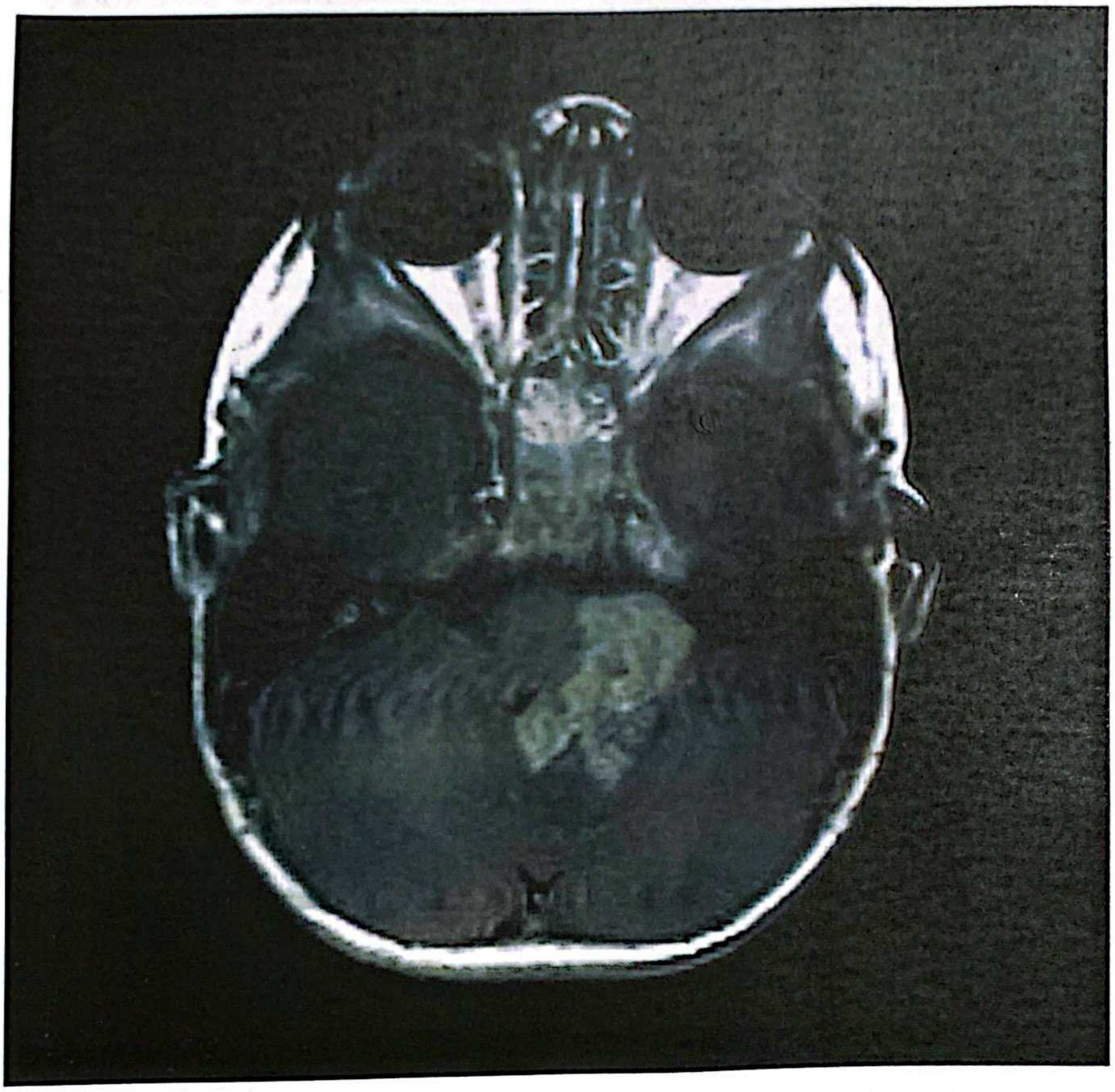
- pilocytic astrocytoma
- atypical teratoid/rhabdoid tumour
- brainstem glioma (exophytic)

Q.17) Ependymoma (2015)



Selected images from an MRI of the brain demonstrate an enhancing passing though the left foramen of Luschka, appearing to arrise from the roof of the 4th ventricle.

CT

Brain

- coarse calcification is common (50%)
- cystic areas (50%)
- solid component iso to hypodense
- heterogeneous enhancement
- variable haemorrhage

MRI

Brain

T1

- solid portions of ependymoma typically are isointense to hypointense relative to white matter 7

T2

- hyperintense to white matter
- more reliable in differentiating tumour margins than non-contrast T1-weighted images (but less reliable than contrast enhanced T1)

T2* (e.g. SWI)

- foci of blooming from haemorrhage or calcification

T1 C+ (Gd)

- enhancement present but heterogeneous
- enhancement with gadolinium is useful in differentiating tumour from adjacent vasogenic oedema and normal brain parenchyma

DWI/ADC

- restricted diffusion may be seen in solid components, especially in anaplastic tumour
- diffusion should be interpreted with caution in masses with significant haemorrhage or calcification

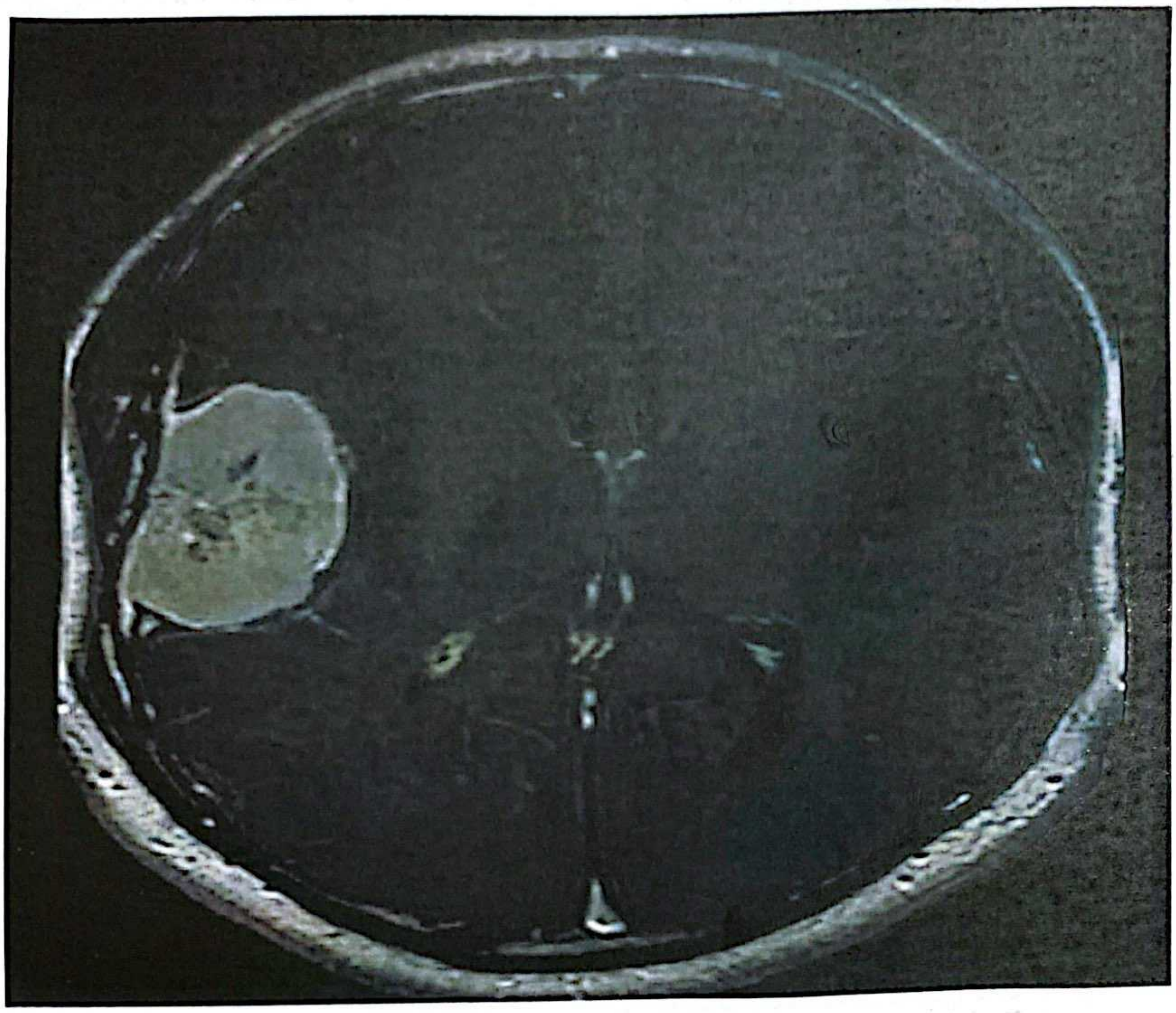
MRS

- Choline peak elevation according to the cellularity of tumour
- NAA peak reduction
- elevated Cho/Cr ratio
- lipid and lactate rise when degeneration occurs
- Although it is uncommon when compared to tumours like medulloblastomas, careful examination of the entire neuraxis is required to assess for the presence of CSF seeding.

Treatment and prognosis

- A total or partial resection could be attempted +/- irradiation.
- Prognosis is, however, relatively poor, which is mainly due to tumours occurring in surgically challenging locations, making complete resection difficult.

Q.18) . Meningioma (2014)



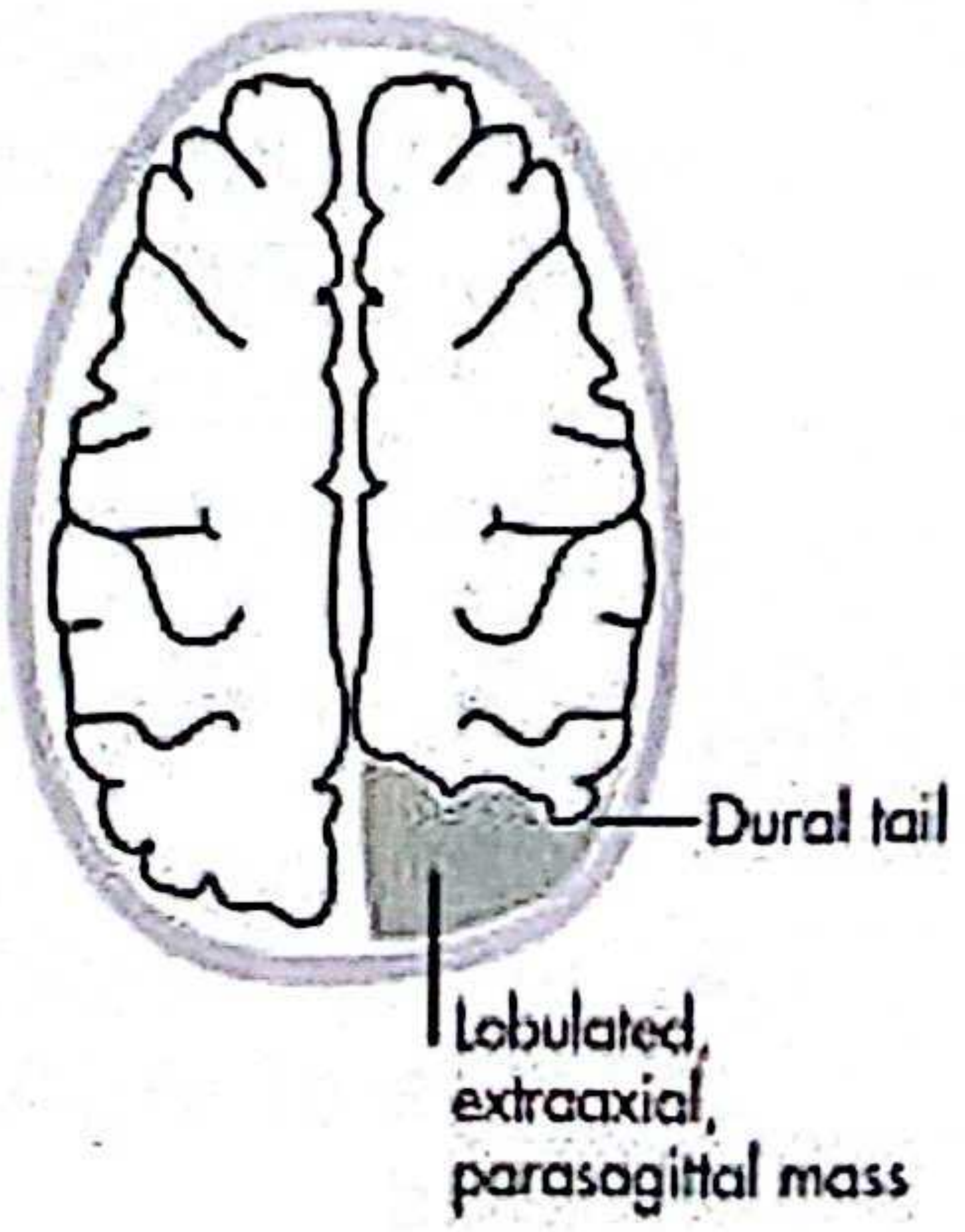
Extra-axial mass with vivid postcontrast enhancement, broad dural base, dural tail sign and central vascular pedicle noted in right sylvian fissure.

Plain film

- Hyperostosis of the bone adjacent to the meningioma.
- Calcification (psammoma bodies) within the tumour may also be identified.

CT

- Sharply demarcated well-circumscribed slowly growing mass
- Wide attachment to adjacent dura mater
- "Cortical buckling" of underlying brain
- Hyperdense (75%) or isodense (25%) on noncontrast CT



- **Strong, homogeneous enhancement, 90% (hallmark)**
- Similar signal intensity as normal falx on enhanced and nonenhanced CT
- Calcifications, 20%
- Cystic areas, 15%
- CSF cleft sign

MRI

- Tumors are typically isointense with GM.
- Strong gadolinium enhancement
- Best technique for detecting dural tail
- Dural tail (60%) is suggestive but not specific for meningioma.
- Increased vascular flow voids

Angiography

- Spokewheel/Sunburst appearance
- Dense venous filling
- Persistent tumor blush ("comes early and stays late") **'mother in law' sign**
- Well-demarcated margins
- Dural vascular supply

*They take up octreotide and Tc-MDP on Nuclear Medicine tests

Age: peak incidence 45 years (range 35-70 years); rare <20 years (in children >50% malignant, M > F);

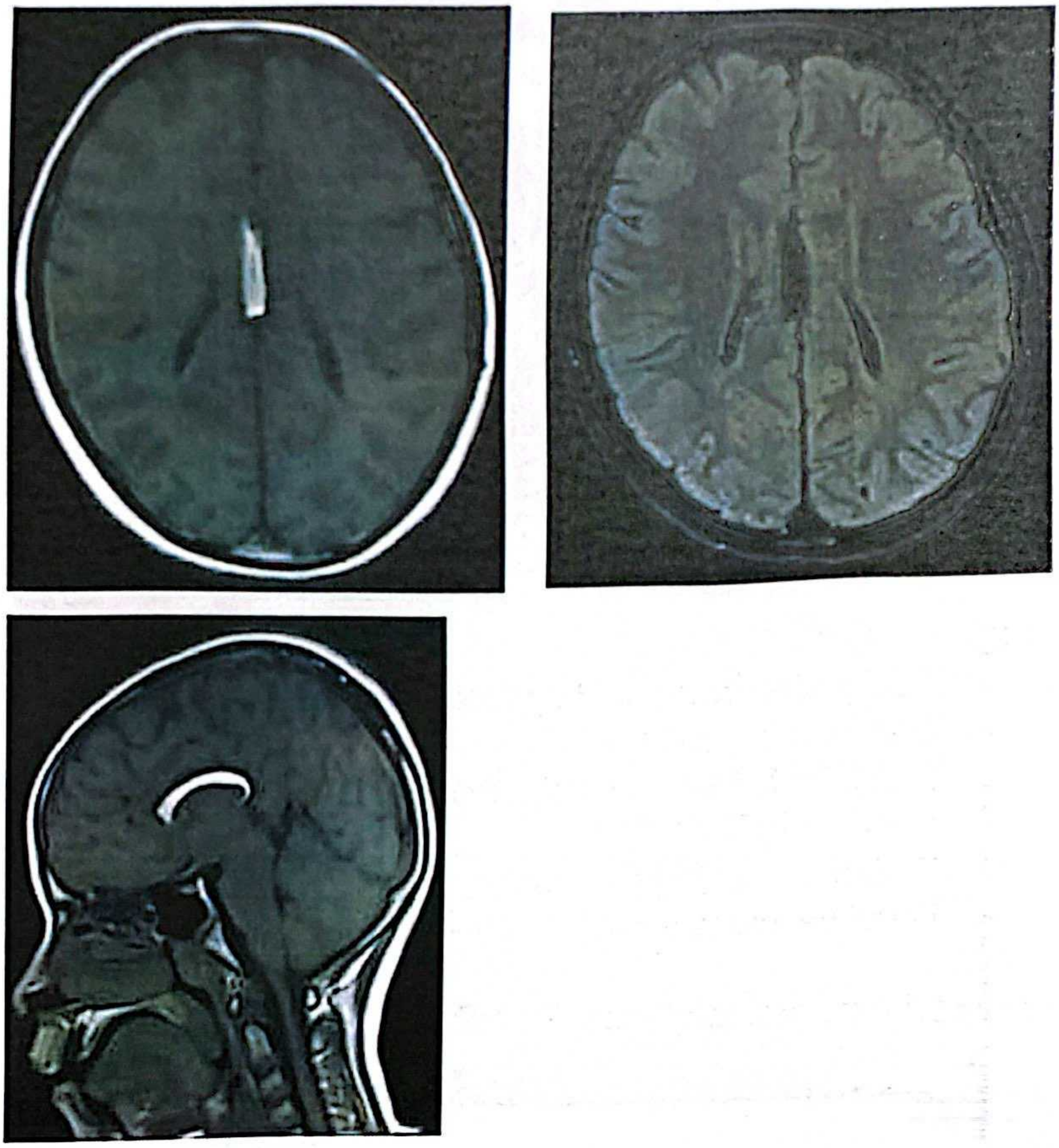
Association:

- Radiation to the head and neck.
- Exposure to female hormones and breast cancer.
- Neurofibromatosis type 2 (multiplemeningiomas, occurrence in childhood)
- Basal cell nevus syndrome

Treatment

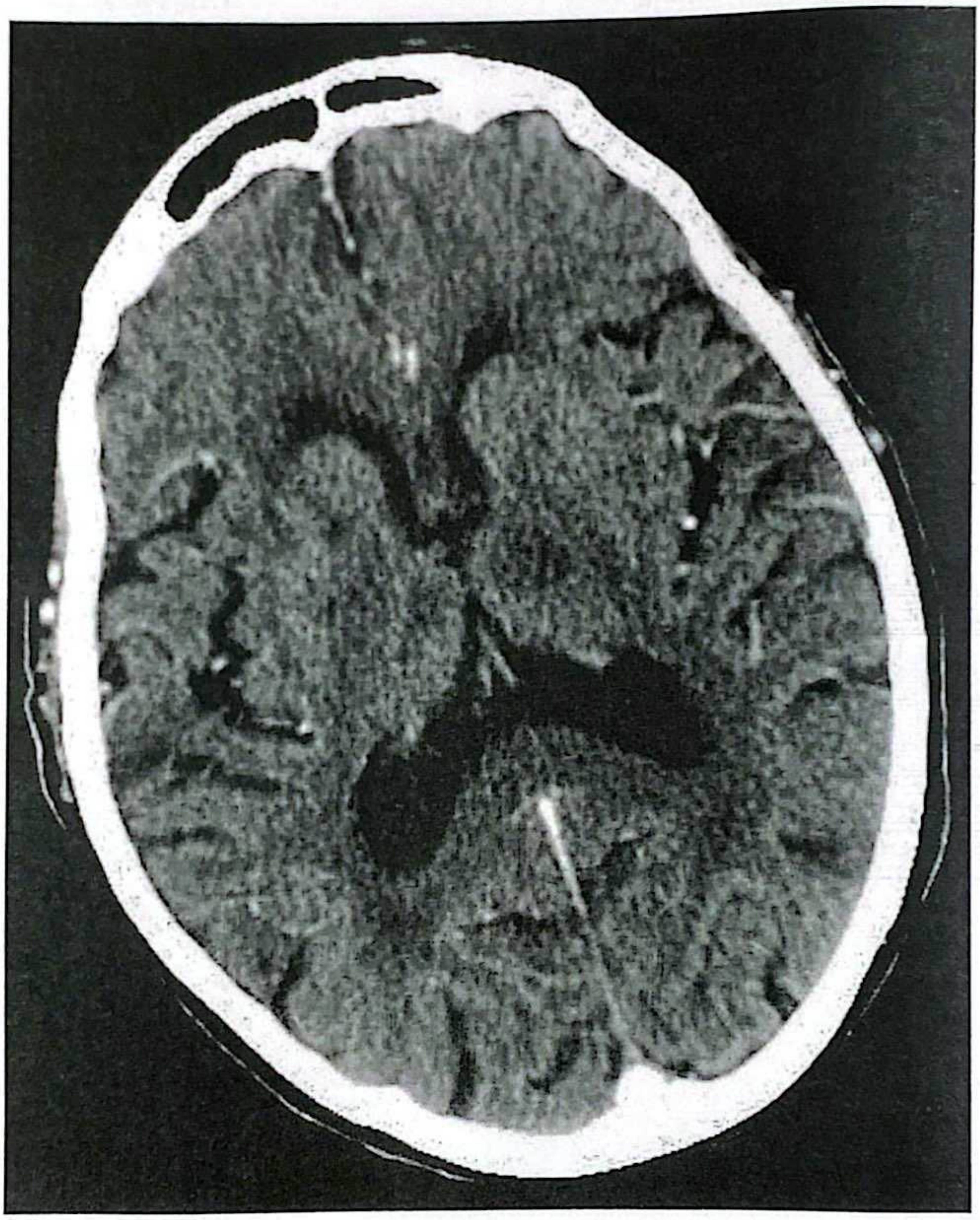
- Treatment is usually with surgical excision.
- If only incomplete resection is possible (especially at the base of skull) then external-beam radiation therapy can be used.

Q.19) **(2015)**



- Curvilinear corpus callosal lipoma is seen interhemispheric in the pericallosal sulcus.
- It exhibits T1 bright signal, less bright signal in T2, suppresses on both T1/SPIR as well as T2/FLAIR with fat saturation. It shows chemical shift artifact around in T1WI. No diffusion restriction
- Corpus callosal dysgenesis evident.
- Normal signal intensity of both cerebral hemispheres with no definite focal abnormalities.
- Normal size and configuration of the ventricular system.
- Normal posterior fossa.

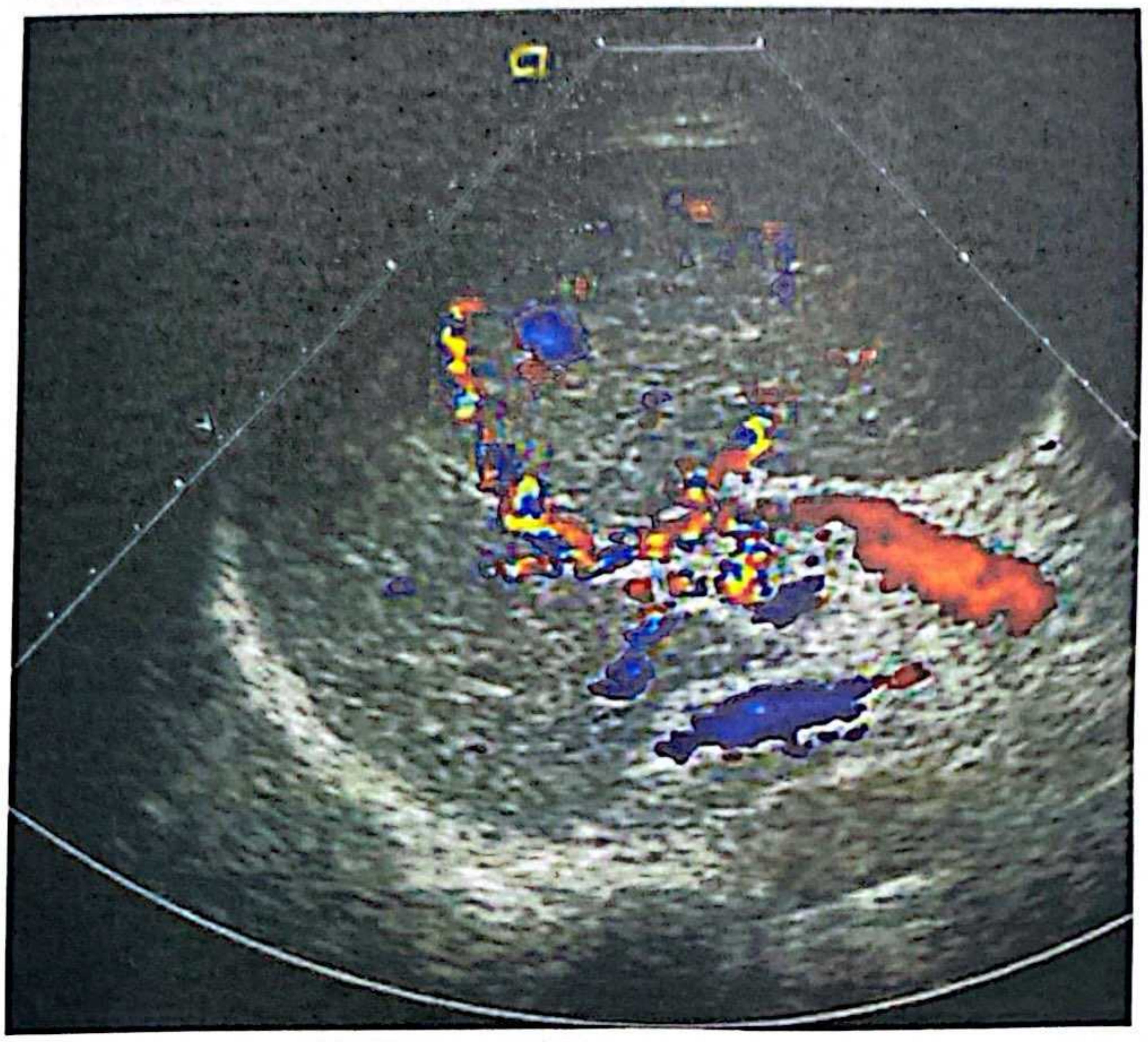
Q.20) (2018)

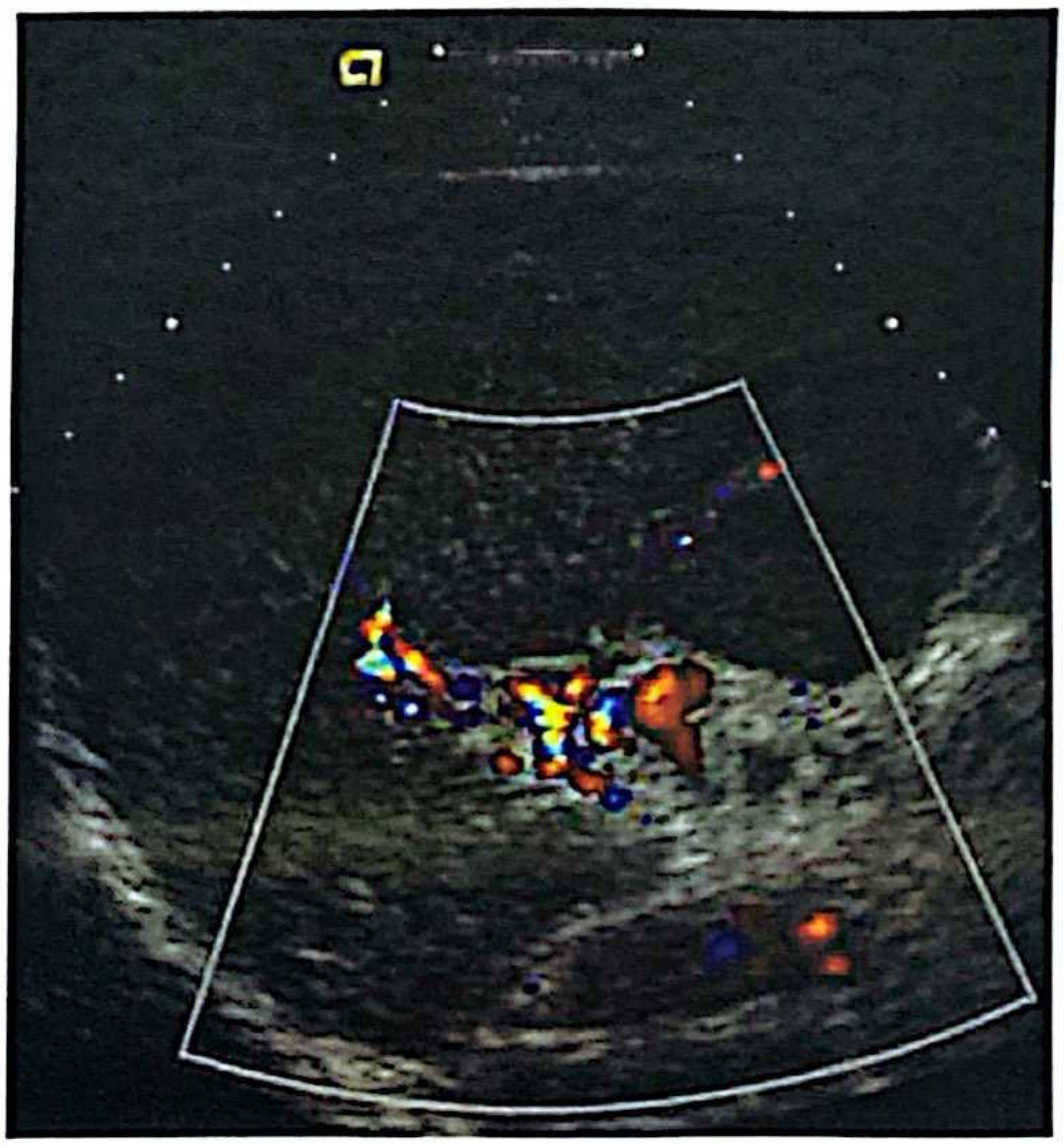


Identify: Contrast Enhanced CT Brain Axial view
Describe: Bilateral thalamic hypodensities seen
Diagnosis: Bilateral thalamic infarction
What next:

- CT angiography (CTA)
- CT perfusion Imaging
- FLAIR MRI
- Diffusion weighted imaging (DWI)

Q.1) Patient with cirrhosis. **(2018)**





Identify: Ultrasound Doppler images transverse views of Liver

Describe:

1. Numerous tortuous cluster of serpiginous vessels extending into the liver.
2. These vessels occupying the portal vein bed.
3. Flow is looking hepatopetal.

Diagnosis: Cavernous transformation of the portal vein

What next:

Multiphase CT can confirm the diagnosis by demonstrating:

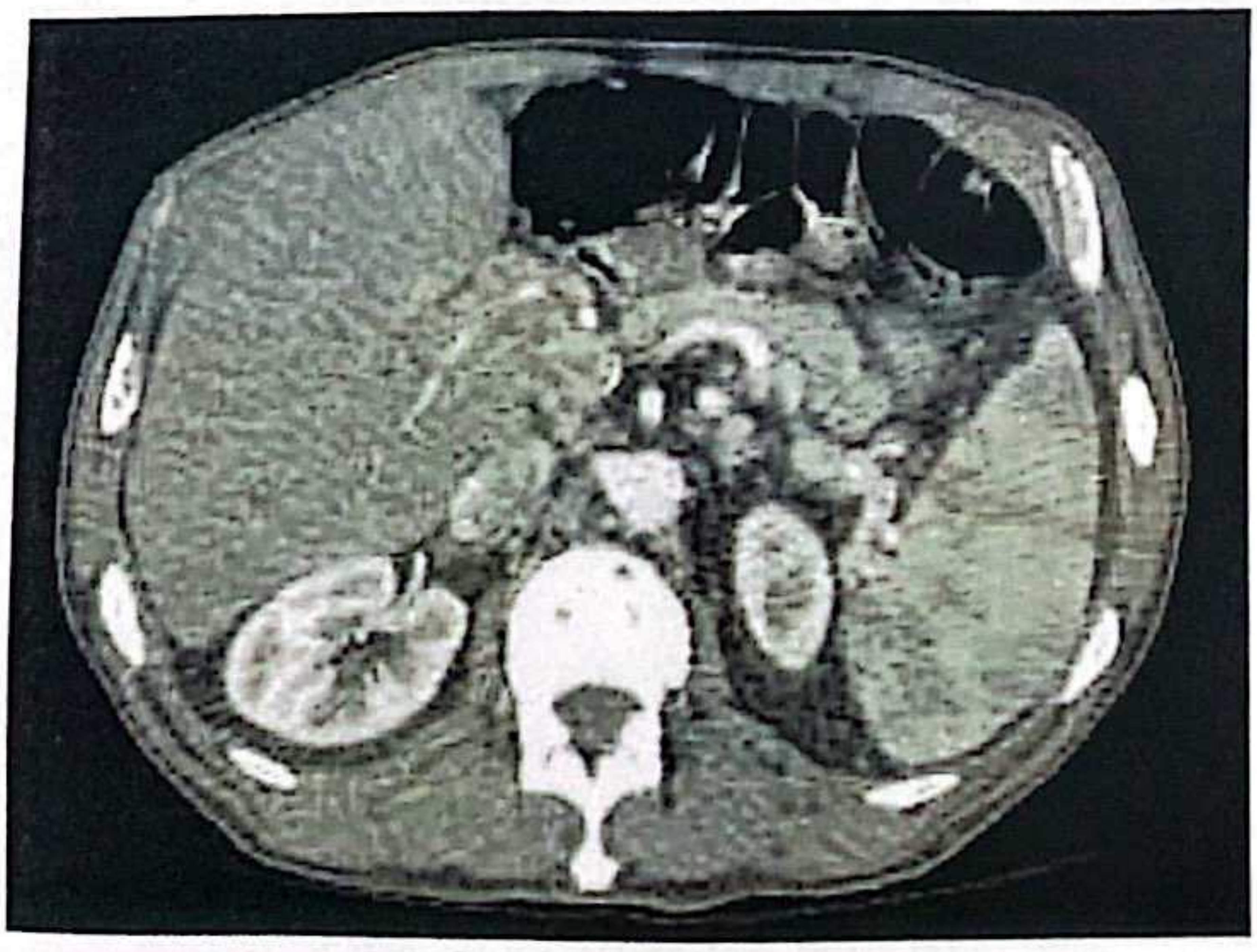
1. Numerous vascular structures in the region of the portal vein, which enhance during the portal venous phase, and not during the arterial phase (distinguishing it from an arteriovenous malformation)
2. Possible linear areas of calcification within the previously thrombosed portal vein indicating chronic venous thrombosis

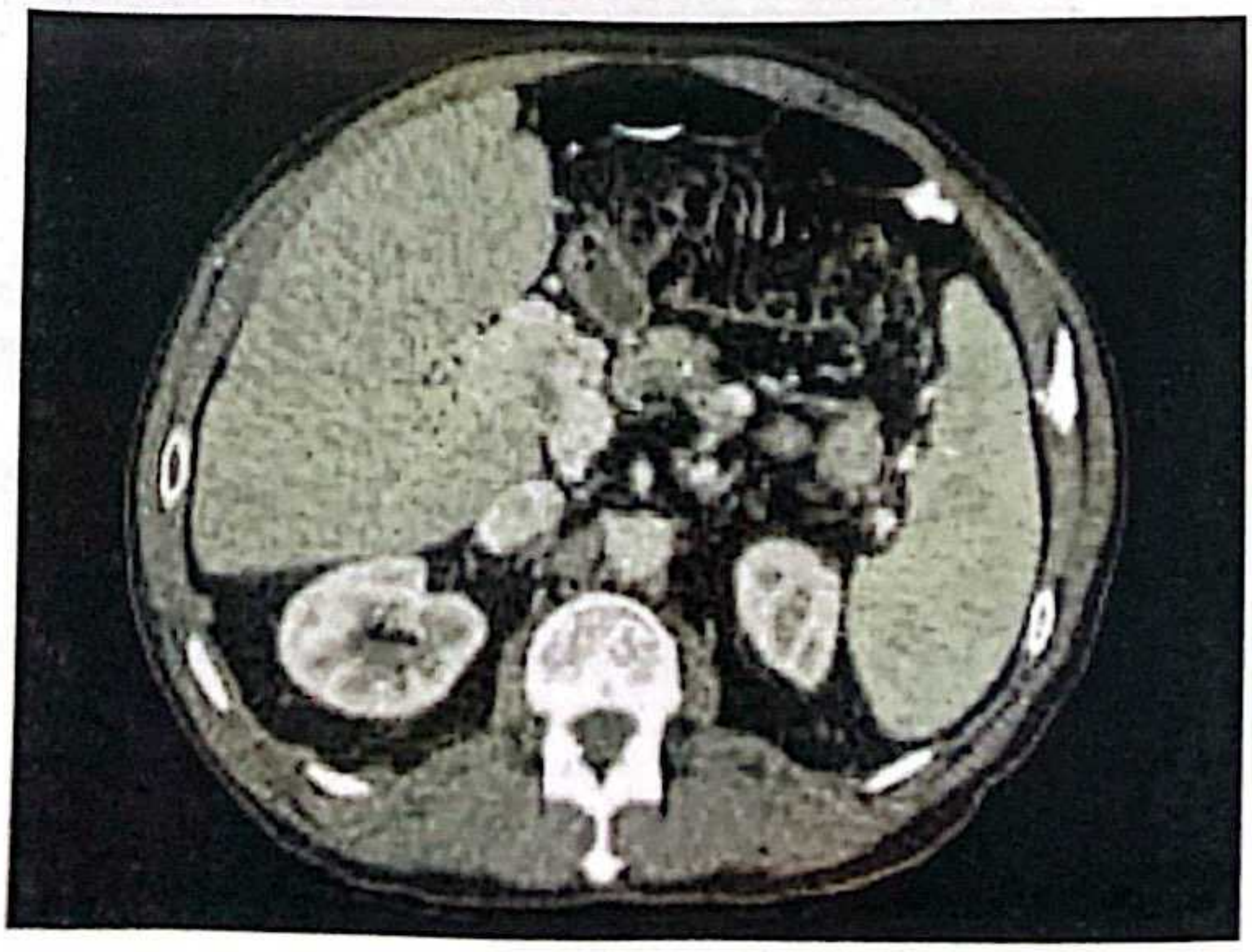
MRI

- MRI is also a proven method for imaging the portal venous system and may be used as a complementary or alternative modality to CT.

Treatment and prognosis

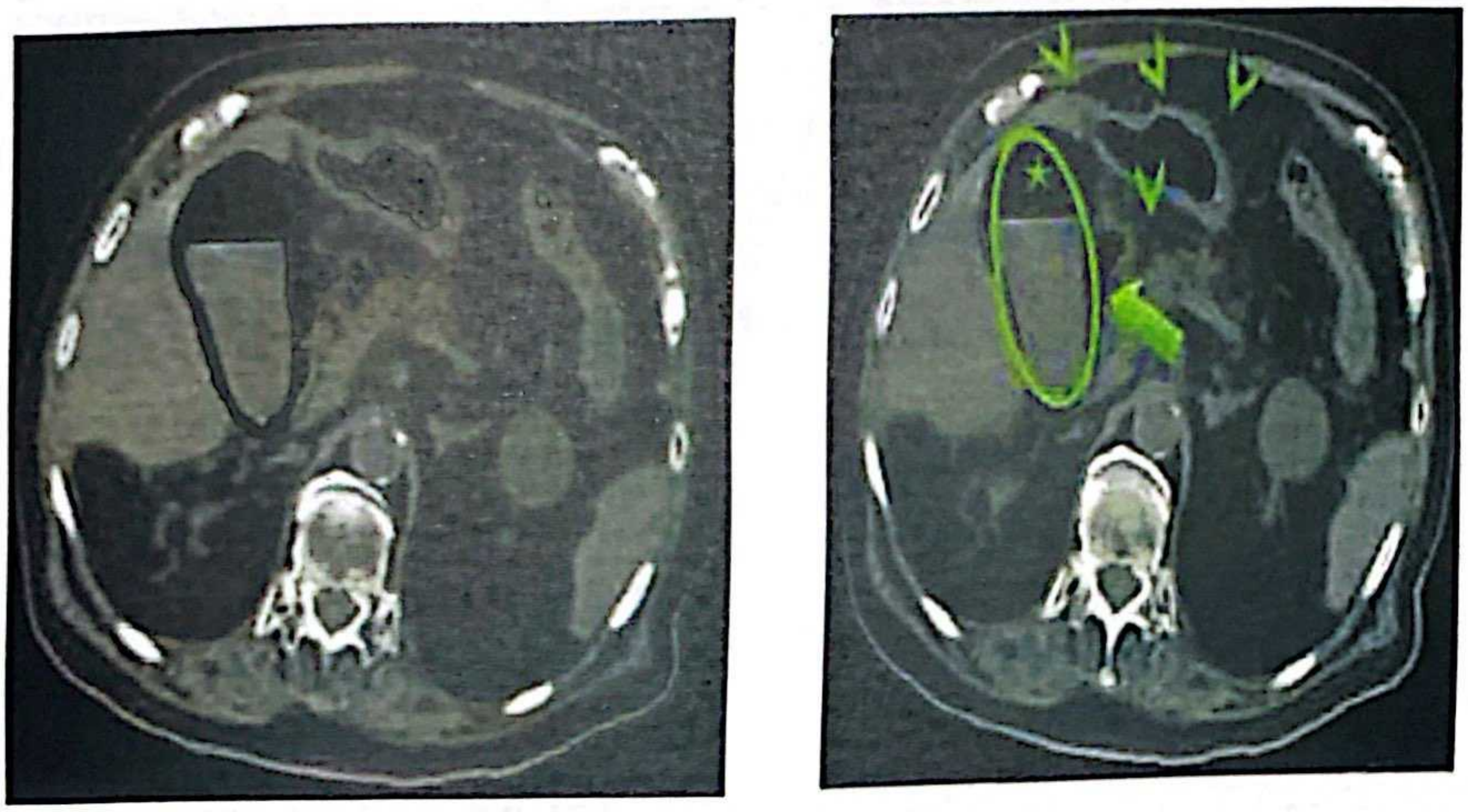
1. Despite collateral formation portal hypertension is usually present with associated complications.
2. Whereas portal hypertension can in some cases be treated with TIPS, the absence of normal portal circulation usually makes this impossible.





Q.2) Severe right upper quadrant pain with sepsis and hypotension AGE: 65-Male Diabetic

(2017)



Gas within the gallbladder indicated by star. Gas within gallbladder wall indicated by solid line. Free gas indicated by open and closed arrows.

Identify: Unenhanced CT Abdomen Axial Section

Describe: Intramural and intraluminal gas collections in gallbladder. Focis of air near the medial gallbladder wall and scattered through peritoneum

Diagnosis: CT findings are compatible with emphysematous cholecystitis with gallbladder perforation and pneumoperitoneum

What next: Nuclear medicine HIDA

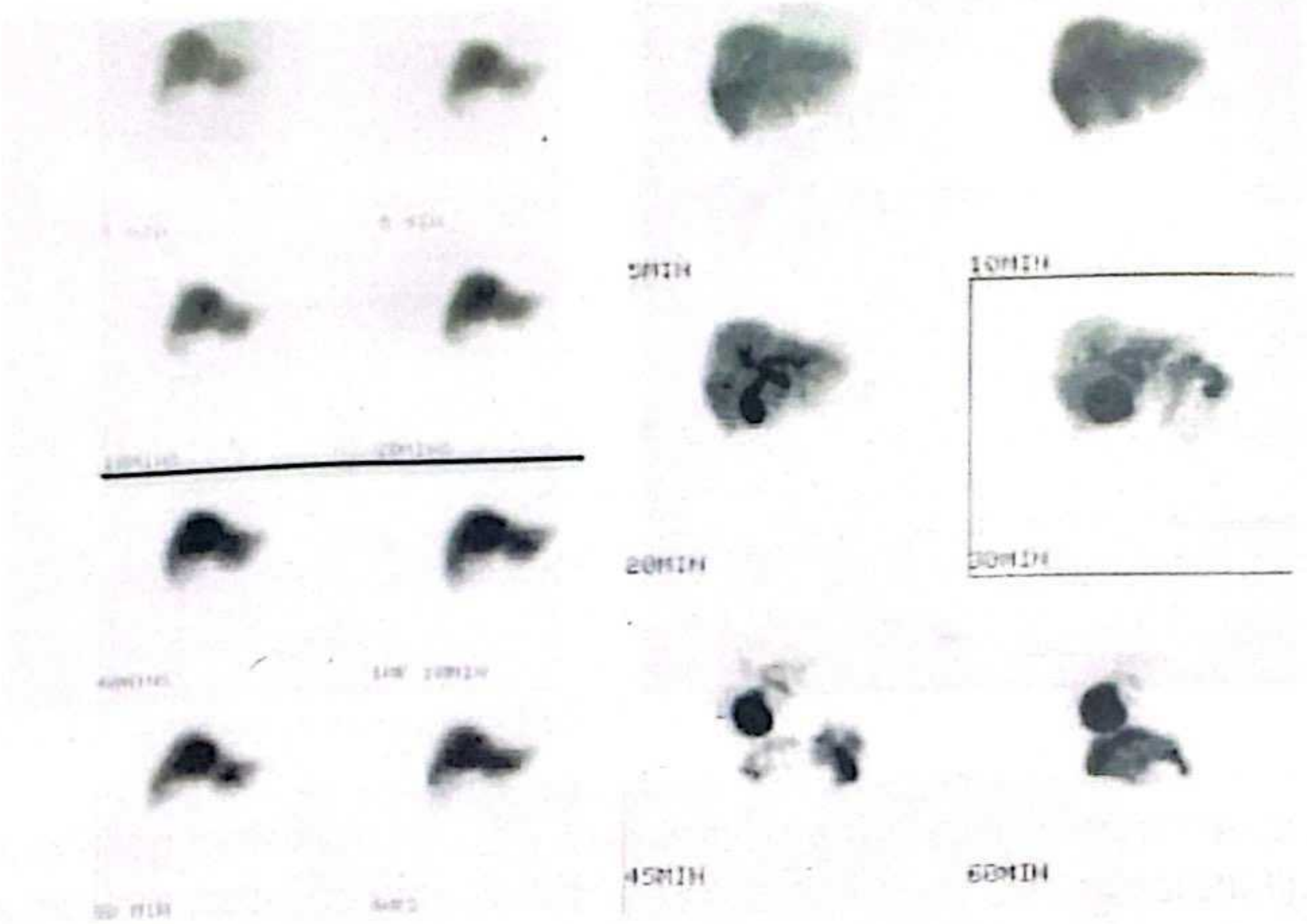
Hepatobiliary nuclear imaging may demonstrate non-visualisation of the gallbladder, along with a region of increased hepatic activity adjacent to the gallbladder fossa. This feature is sometimes termed the rim sign

Treatment and prognosis

Treatment is emergent surgical intervention. Percutaneous cholecystostomy tube placement may be an option for patients who are too unwell for surgery

Q.3) Ongoing right upper quadrant pain particularly after meals. Normal ultrasound with no cholelithiasis--AGE: 35-Female

(2017)



Identify: Hepatobiliary iminodiacetic acid (HIDA) scan (also known as cholescintigraphy)
Describe: Demonstrating normal (left) and abnormal (right) uptake.
Diagnosis: The abnormal scan is characteristic of cholecystitis
What next: MRCP

- Tc labeled iminodiacetic acid is injected via an IV catheter followed by sequential imaging.
- Obstructing gallstones are characterized by lack of uptake of the tracer in the gallbladder and the cystic duct.
- Gallbladder contraction can be assessed by amount of tracer emptying after administration of cholecystokinin

Films

1. 1-min 128x128 dynamic images are acquired for 45 min after injection.
2. **30–45 min post-injection when the gallbladder is well visualized**, a liquid fatty meal (e.g. 300ml full cream milk) is given through a straw to stimulate gallbladder contraction and imaging continued for a further 45 min. A gallbladder ejection fraction can be calculated.

3. If the gallbladder and duodenum are not seen, static images are obtained at intervals up to 4–6 h.

4. If images are suggestive of reflux, 100–200ml of water is given through a straw to diffuse any activity in the stomach and thereby differentiate it from nearby bowel activity. 4 min before the end of imaging, 100 ml of water containing 10MBq 99mTc-pertechnetate may be given to delineate the stomach.

5. If no bowel activity is seen by 4–6 h and it is important to detect any flow of bile at all, e.g. in suspected biliary atresia, a 24-h image should be taken

Bloodstream

tracer binds predominantly to albumin, which decreases renal excretion (renal excretion seen in most normals); dissociation of albumin + Tc-99m IDA takes place at space of Disse

Liver

peak liver activity 5-15 min-post injection-hepatic phase; 85% extracted by hepatocytes; tracer enters anion pathway of bilirubin

Delayed liver uptake implies hepatocyte dysfunction

CHF (less likely)

Look for liver lesions on early images

Bile

secretion by hepatocytes without conjugation; CBD +cystic duct visualized within 10-30 min (not always visualized in normals);

GB visualized by 20-60 min

Activity in right paracolic gutter I intraperitoneal space implies postoperative bile leak

Bowel

excretion into duodenum by 30 min; **bowel visualized within 1 hr**; no enterohepatic recirculation

Indications

1. Suspected acute cholecystitis
2. Assessment of gallbladder, common bile duct and sphincter of Oddi function
3. Assessment of neonatal jaundice where biliary atresia is considered
4. Suspected bile leaks after trauma or surgery
5. Investigation of biliary drainage
6. Confirmation of biliary dilatation

7. May be used in cases where ultrasound is unavailable.

Equipment

1. Gamma-camera
2. Low-energy general purpose collimator.

Patient preparation

1. Nil by mouth for 4–6 h
2. For the investigation of biliary atresia, infants are given Phenobarbital orally 5mg/kg

1 day

1 in two divided doses for 3–5 days prior to the study to enhance hepatic excretion of radiopharmaceutical.

Technique

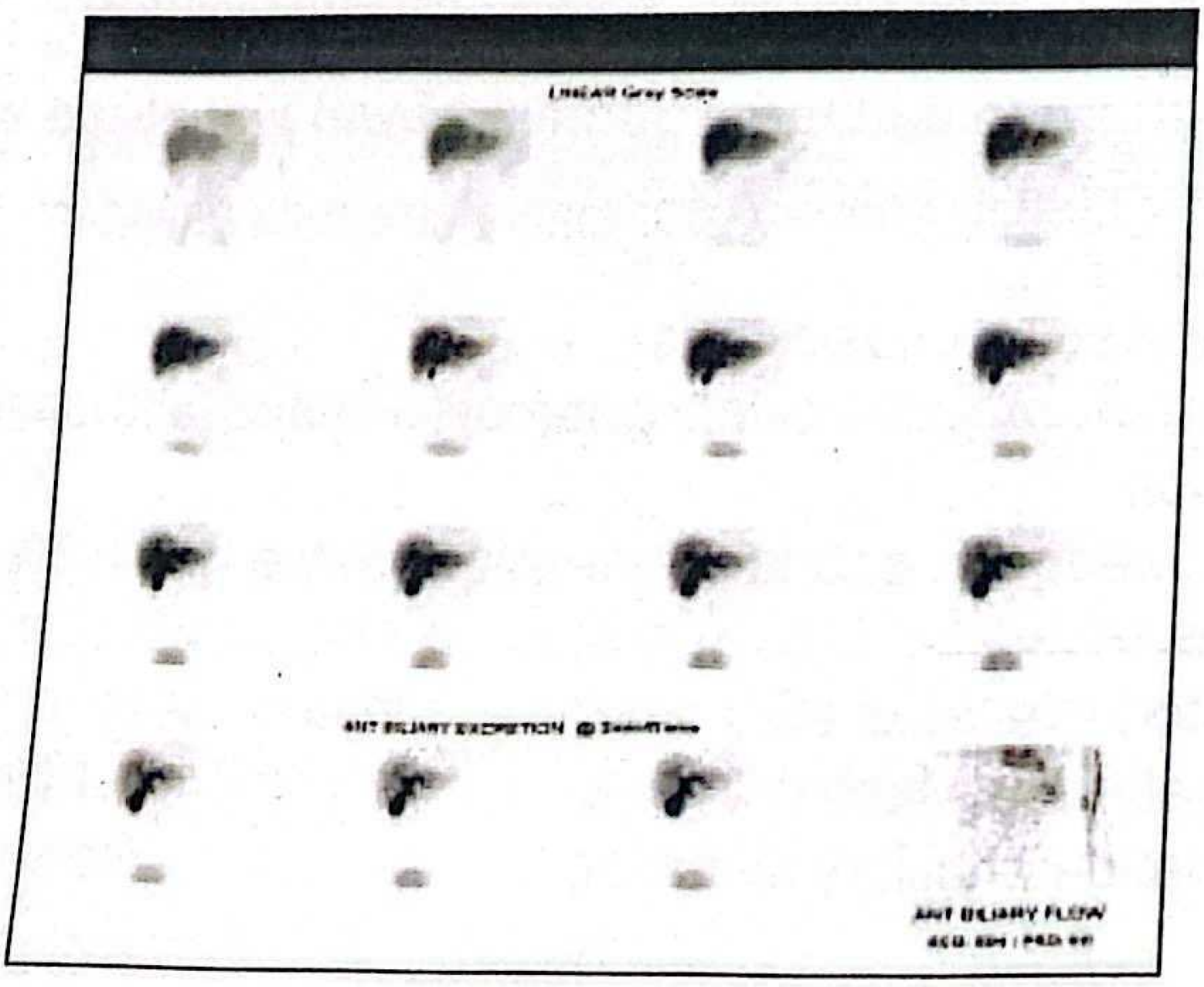
The imaging protocol depends upon the clinical question being asked. A dynamic study should be performed where it is important to visualize the progress of the bile in detail, e.g. post-surgery:

1. The patient lies supine with the camera anterior and liver at the top of the field of view
2. The radiopharmaceutical is injected i.v

Cholecystokinin (CCK) and morphine provocation

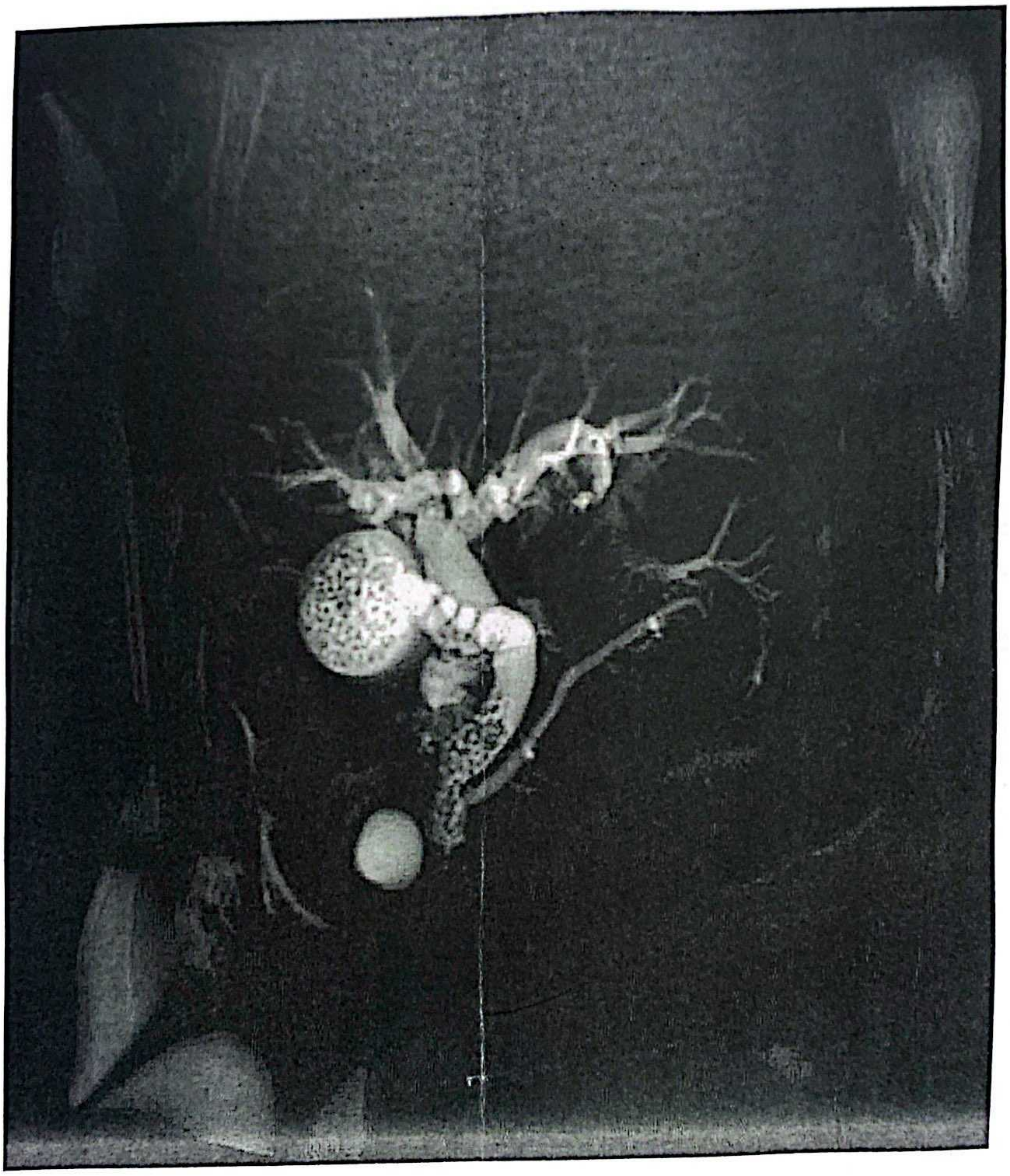
Pharmacological intervention can be used in combination with TBIDA scanning to improve diagnosis of diseases affecting the gallbladder, common bile duct or sphincter of Oddi

- *Uniform radiotracer activity throughout the liver*
- *Prompt excretion into the bile ducts*
- *Radioactivity tracer activity seen in the gallbladder after 10 min*
- *Ongoing accumulation of radiotracer over the 30 min study*
- *Normal cholescintigraphy (HIDA) scan*



Q.4) **Local radiologist noticed a fellow worshipper at his local mosque is jaundiced. Intermittent right upper quadrant pain. Dilated CBD on ultrasound-AGE: 75 years-Male**

(2014)



Identify: Magnetic resonance cholangiopancreatography (MRCP) coronal MIP Image

Describe: Enumerable stones in the gallbladder - most of which are less than 5mm, just waiting to 'drop' into the common bile duct. The distal common bile duct contains at least 20 stones.

Severe intra and extra-hepatic duct dilatation due to obstructing stones.

Diagnosis: Cholelithiasis & Choledocholithiasis: shake, rattle and stones

What next: ERCP

Interval cholecystectomy is advised as the bag of remaining stones is almost certain to keep discharging stones into the CBD again.

Indications

1. Investigation of obstructive jaundice
2. Suspected biliary colic/ bile duct stones
3. Suspected chronic pancreatitis
4. Suspected sclerosing cholangitis
5. Investigation of jaundice or cholangitis in patients who have undergone biliary enteric anastomosis
6. Prior to ERCP/PTC.
7. Identification of congenital anomalies of the cystic and hepatic ducts
8. Post-surgical biliary anatomy and complications
9. Pancreas divisum
10. Anomalous pancreaticobiliary junction
11. Choledocholithiasis
12. Biliary strictures
13. Chronic pancreatitis
14. Pancreatic cystic lesions
15. Trauma to biliary system

Technique

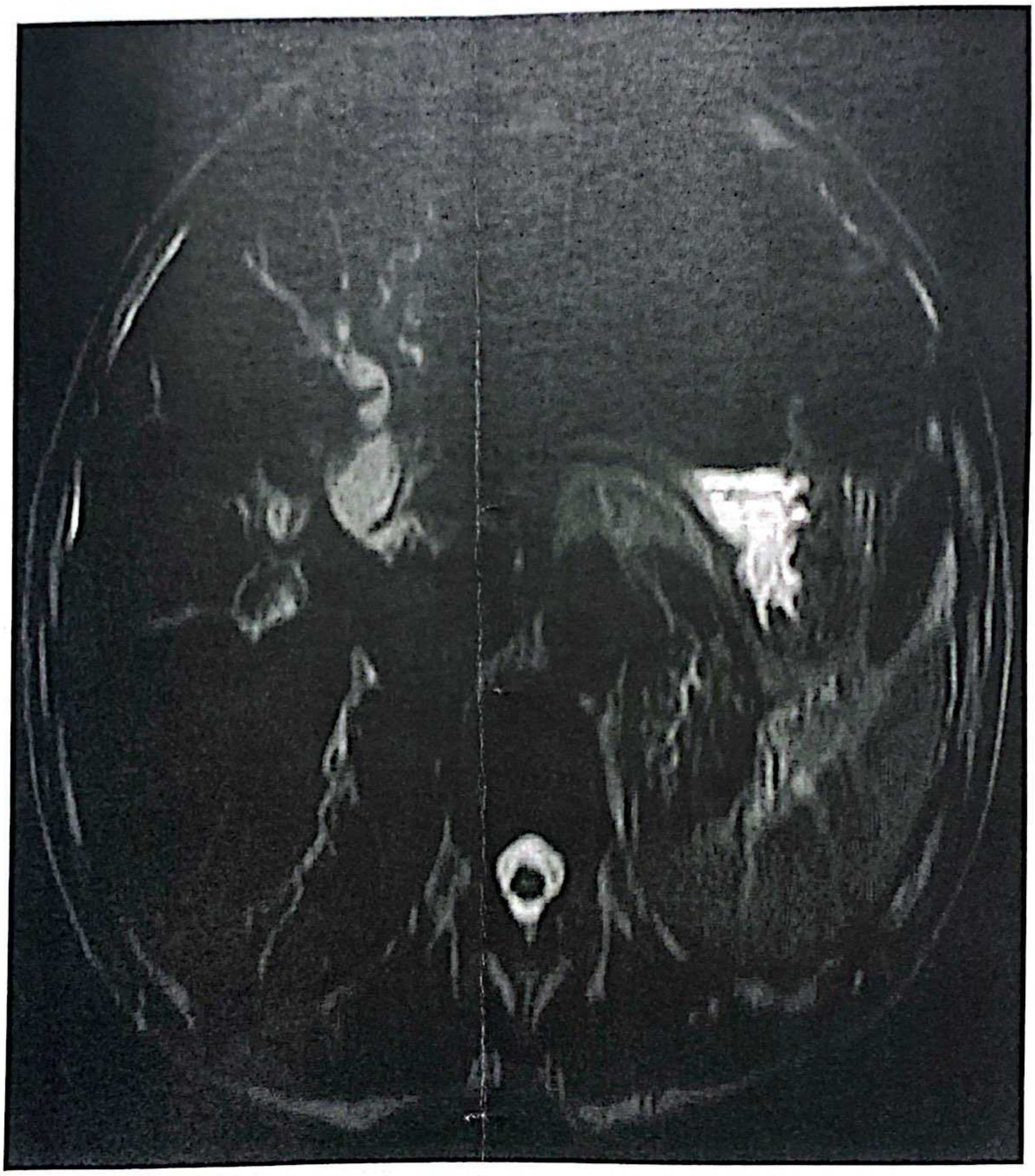
MRCP is a non-invasive technique which uses heavily T2-weighted images to demonstrate the intra- and extra-hepatic biliary tree and pancreatic duct. Most commonly used to demonstrate the presence of stones and the level and cause of obstruction, especially combined with cross-sectional MRI, in cases of tumour or suspected tumour.

Most commonly obtained sequences are:

- **RARE**: rapid acquisition and relaxation enhancement
- **FRFSE**: fast-recovery fast spin-echo coronal oblique 3D respiratory triggered
- **HASTE**: half-Fourier acquisition single shot turbo spin echo-Axial 2D breath hold sequence which provide superior images and can be performed in single breath hold (<20 sec) and a fat suppressed sequence
- additional sequence which can be acquired to evaluate duct wall is fat suppressed T1 GRE sequence

Q.5) **2 weeks of jaundice and itching. US reveals intrahepatic biliary radicle dilatation--59 years old-Male**

(2016), (2018)



Identify: Magnetic resonance cholangiopancreatography (MRCP) coronal MIP Image

Describe: common hepatic duct is amputated at the confluence site of hepatic ducts being totally obstructed for a short segment.

Irregular/ shouldered margins

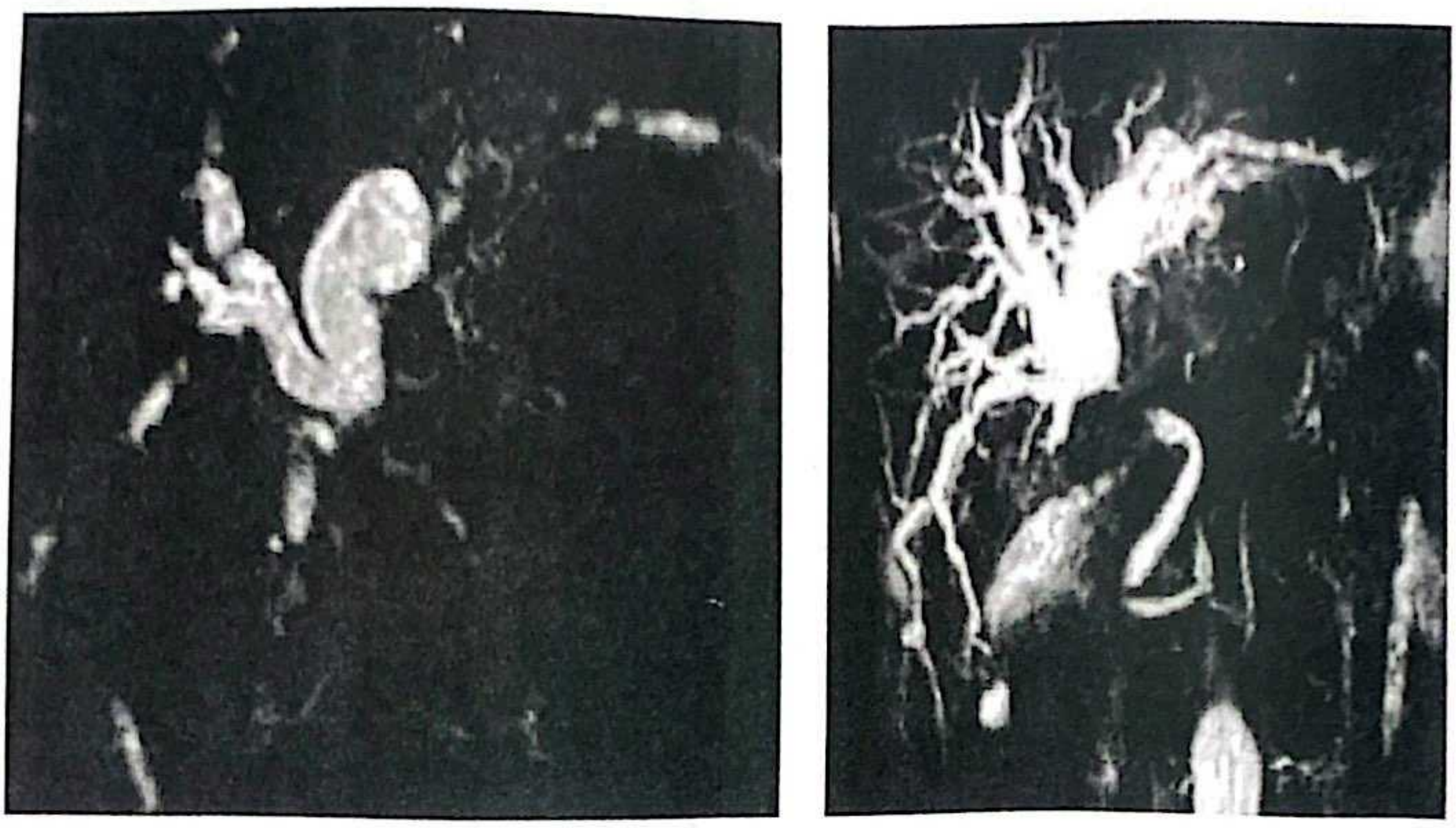
Secondary dilatation of the intra hepatic biliary radicles of both hepatic lobes, more in left lobe

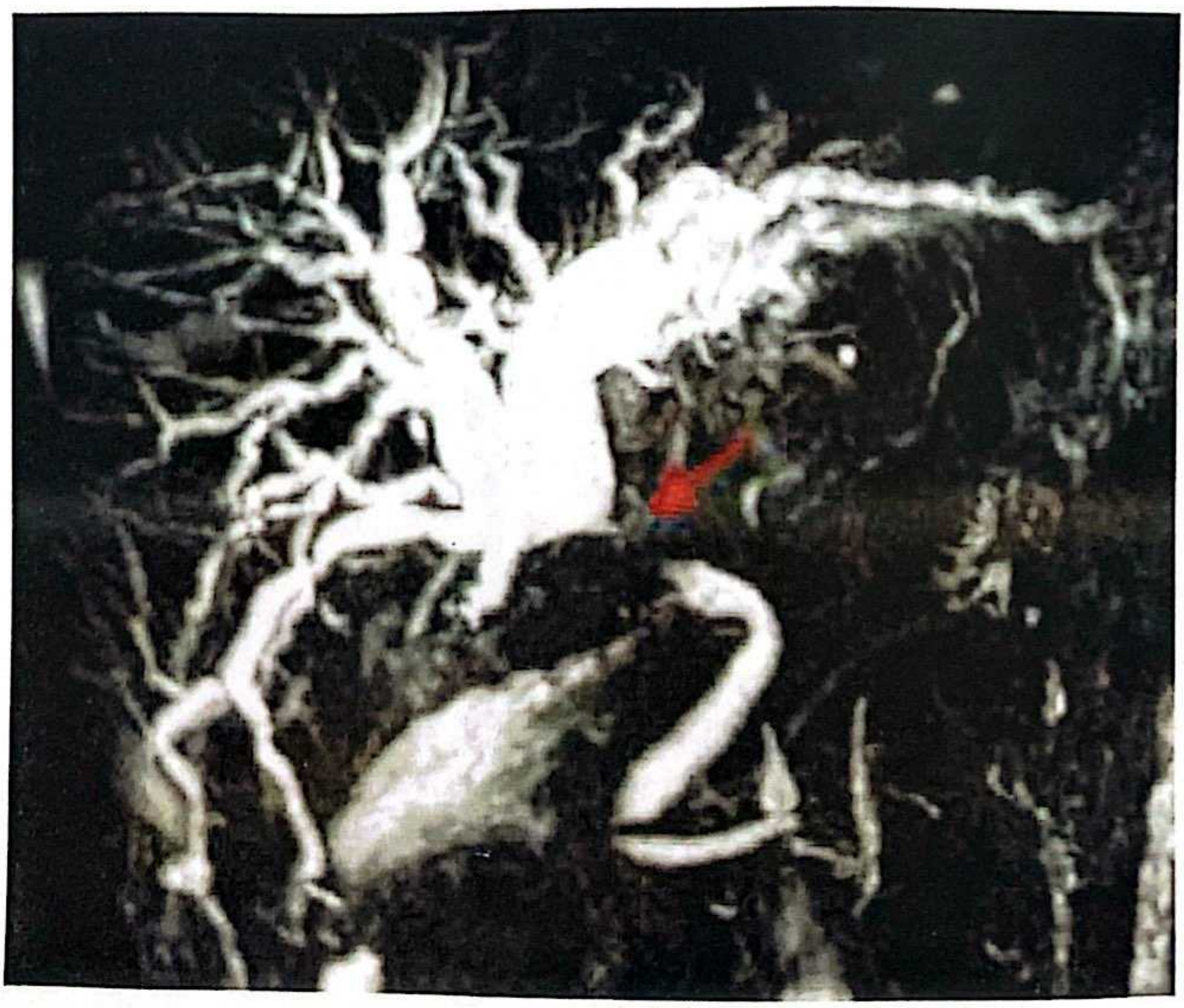
Diagnosis: Hilar cholangiocarcinoma (Klatskin tumor)

Differential Diagnosis:

Malignant: Periampullary carcinoma

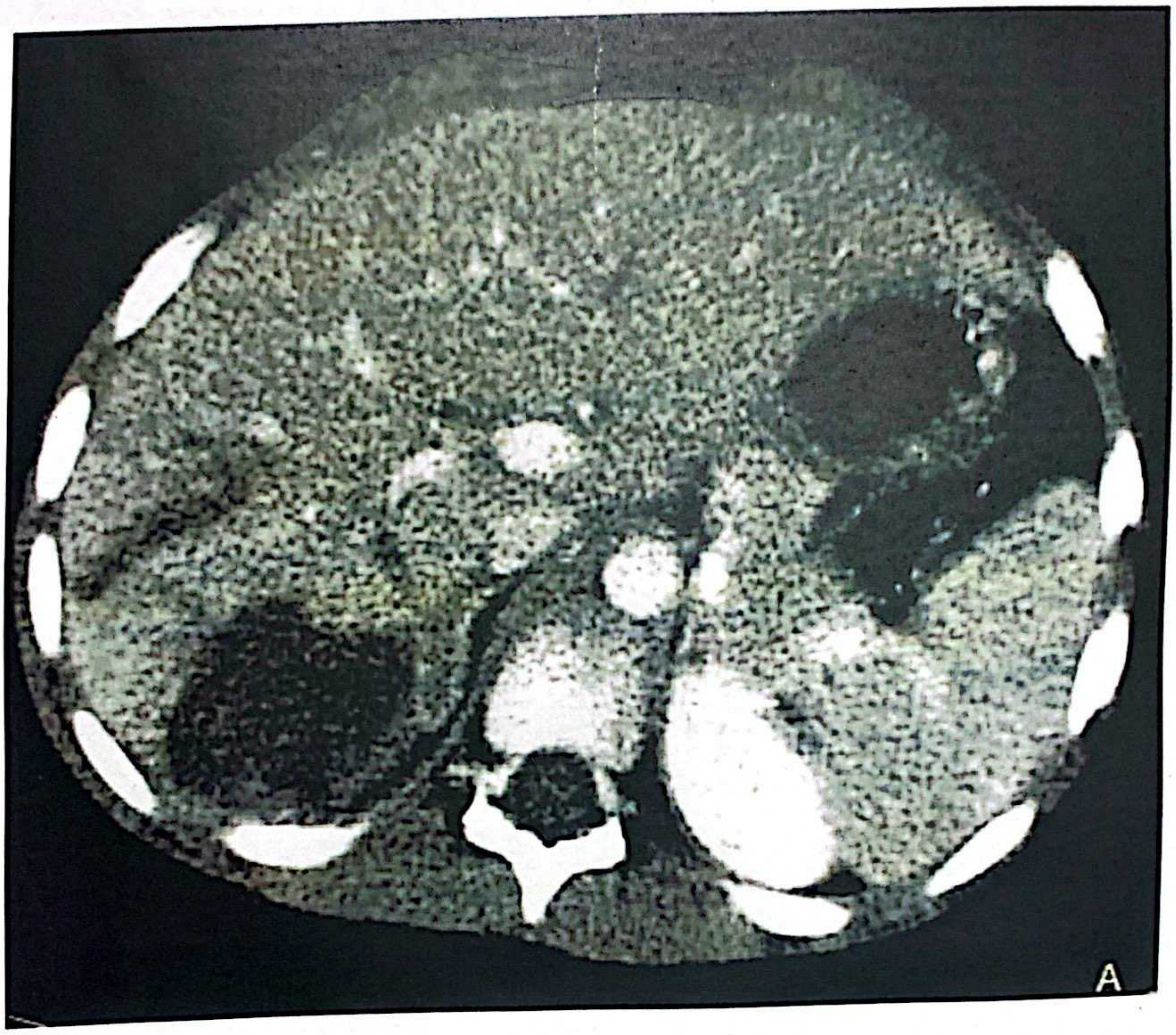
Benign: Diathermy burns, haemostasis clips
previous anastomosis (e.g. post liver transplant)
Primary sclerosing cholangitis





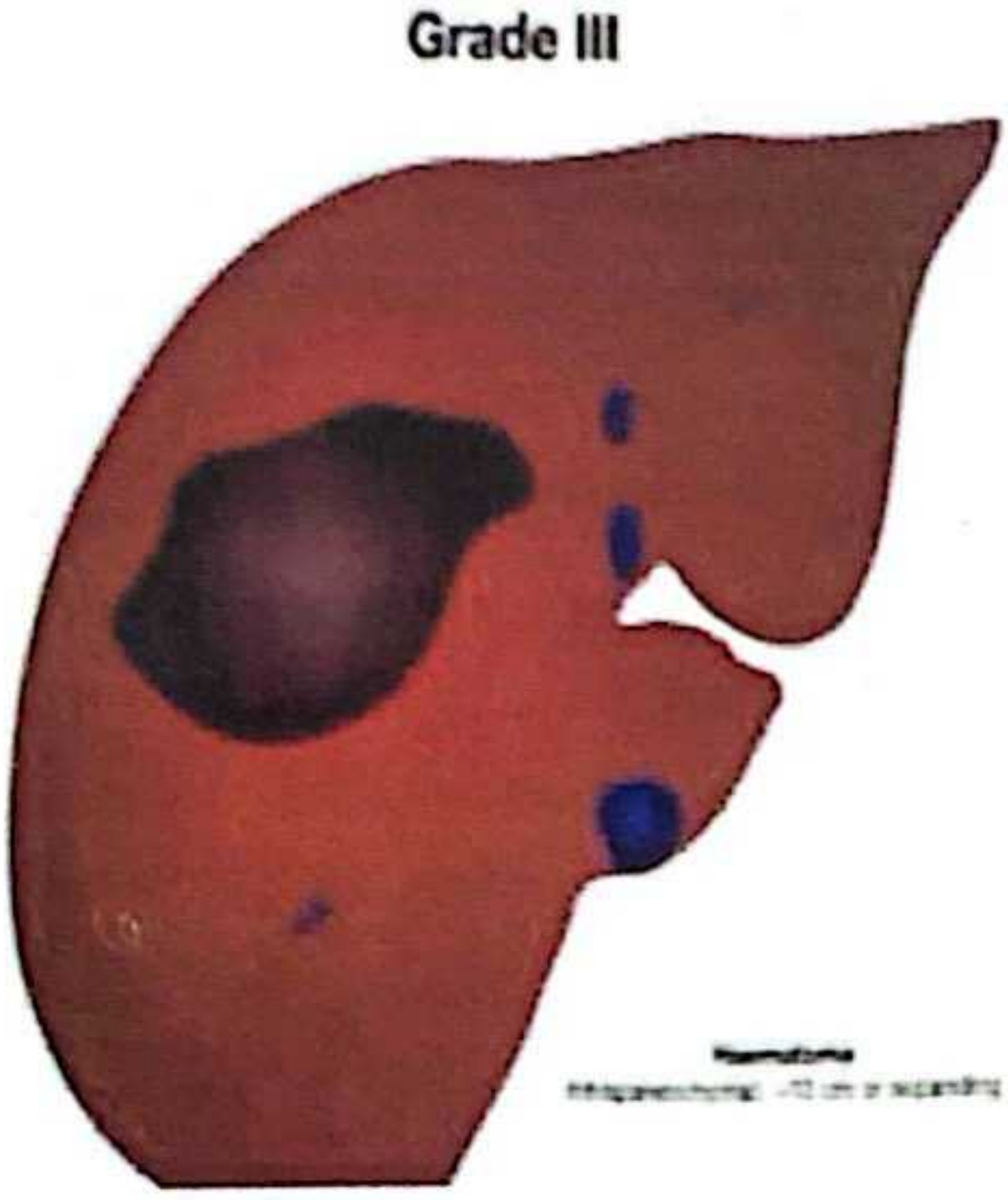
Q.6) Falling from the 2nd floor followed by severe right flank pain-AGE: 8 years old-Male

(2016)

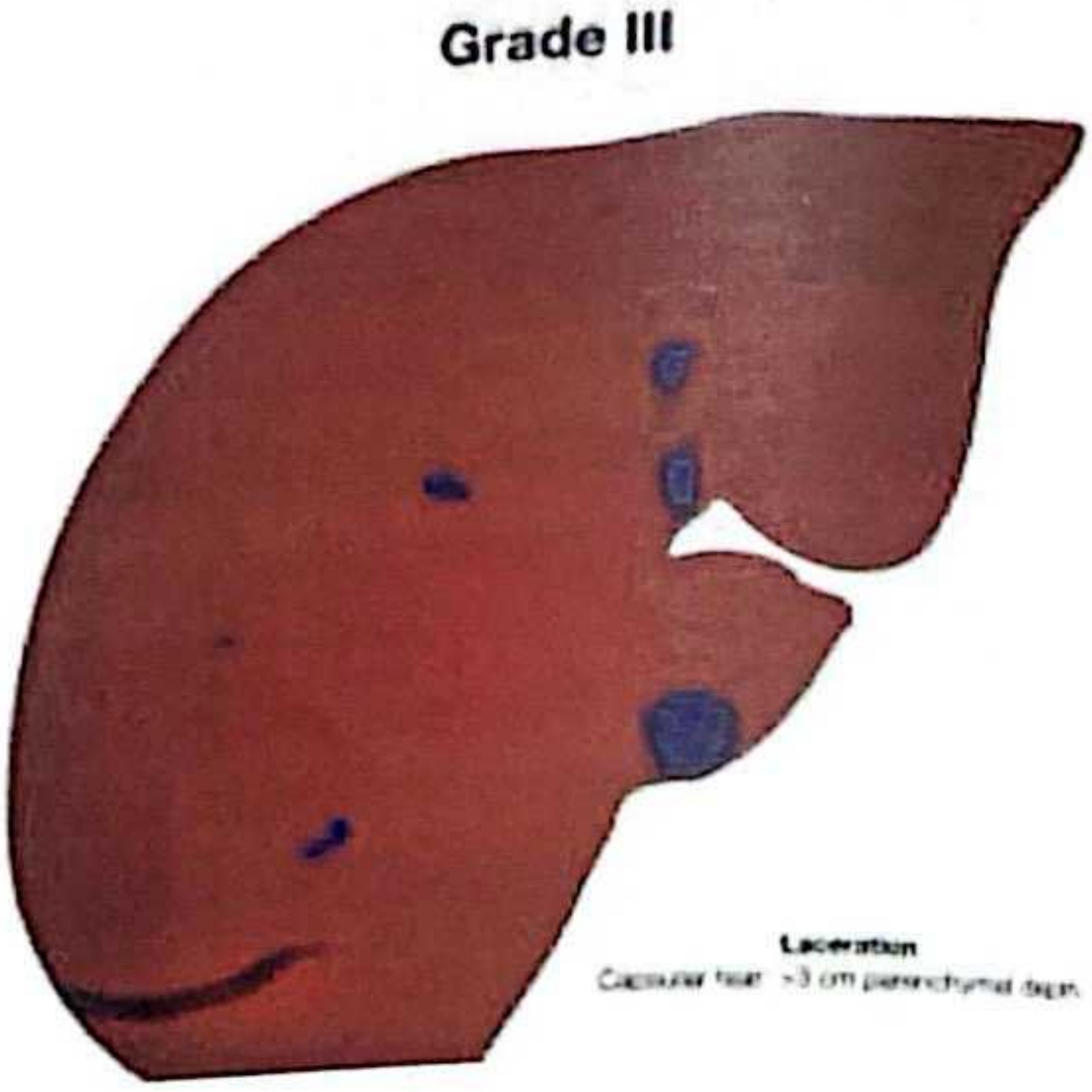


Identify: Enhanced Computed Tomography Scan Abdomen
Describe: Multiple deep linear branching hypodense lacerations are seen involving the posterior segment of right hepatic lobe with associated large hypodense subcapsular parenchymal hematoma. No evidence of contrast blush or active bleeding. Intact vascular pedicle.
Diagnosis: Liver injury Grade III
Treatment and prognosis
Most (>80%) of liver injuries can be treated non-surgically, and in blunt trauma relies on haemodynamic stability rather than a grade of injury. AAST (American Association for the Surgery of Trauma) liver injury scale
Complications

- bile duct injury leading to bile peritonitis or biloma
- delayed haemorrhage
- intra-abdominal abscess formation
- acute acalculous cholecystitis

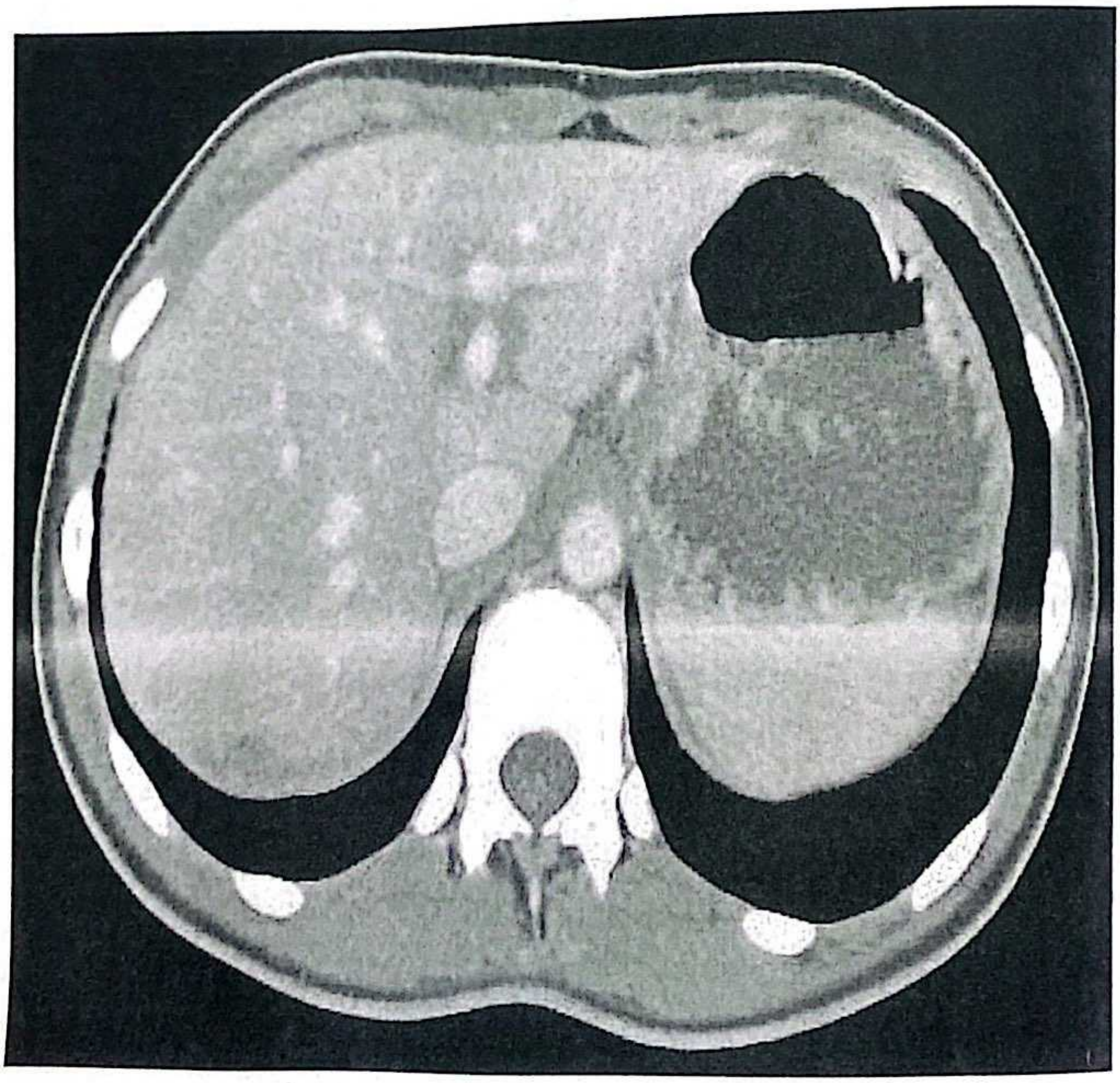


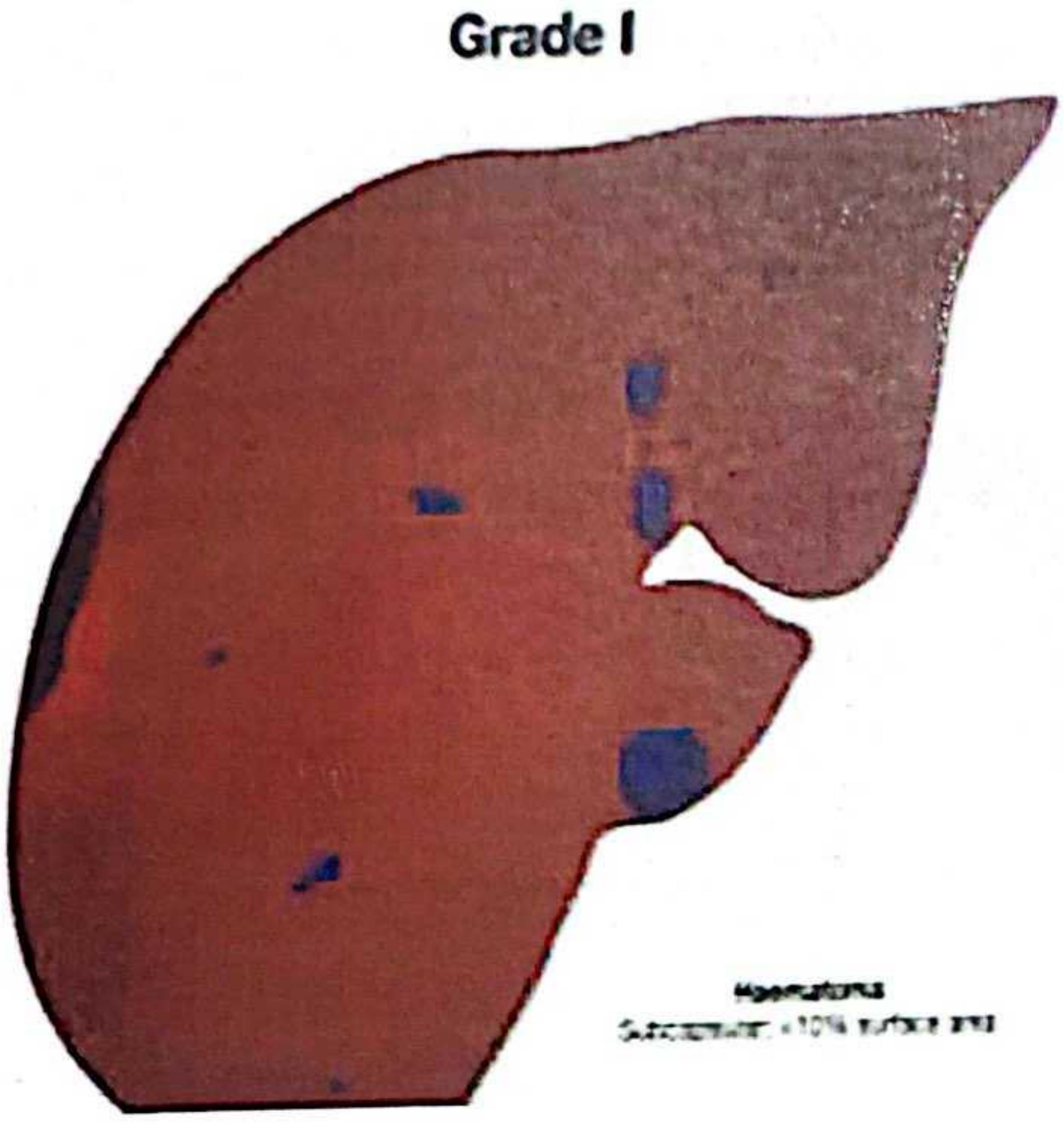
Grade III

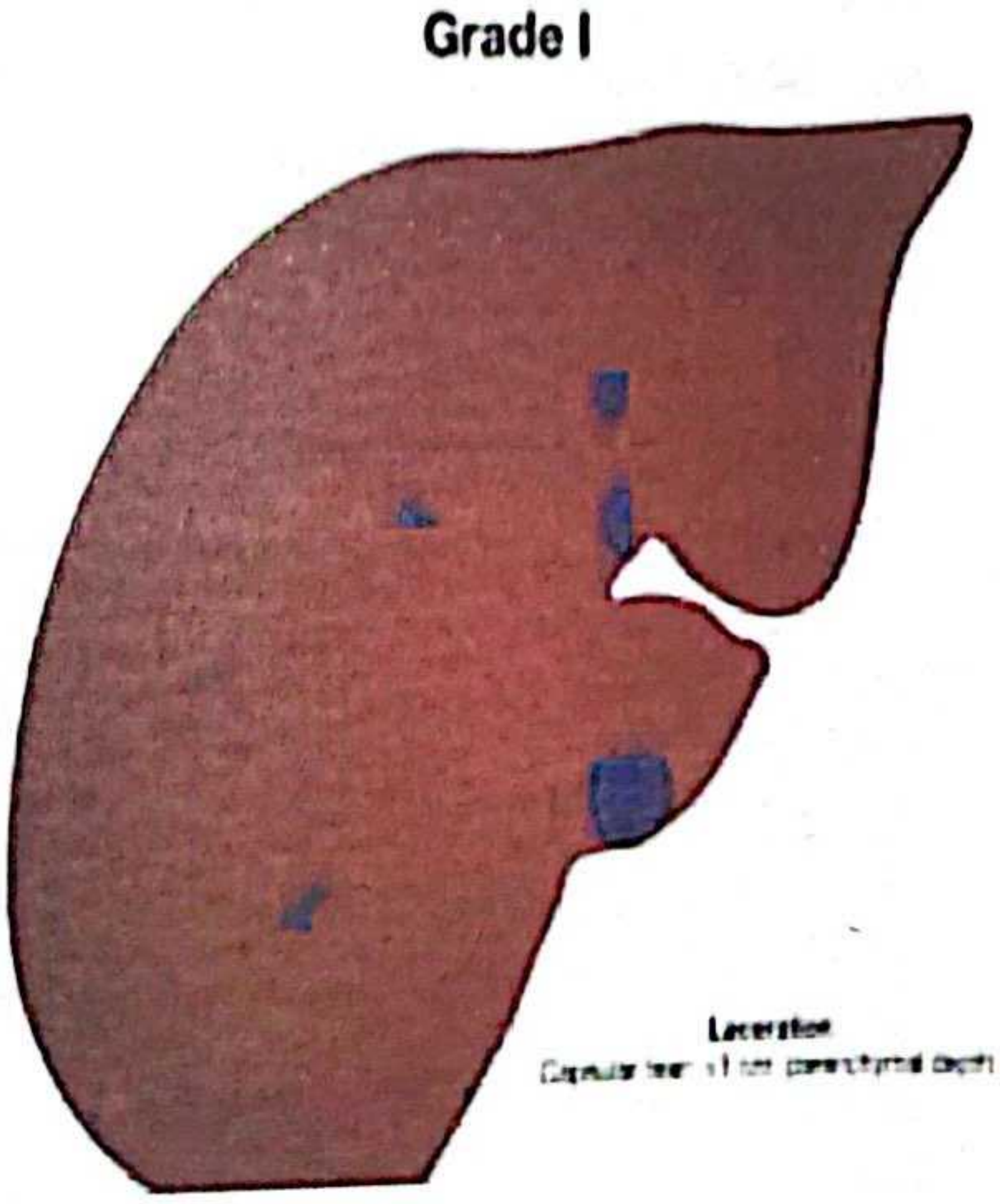


Grade III

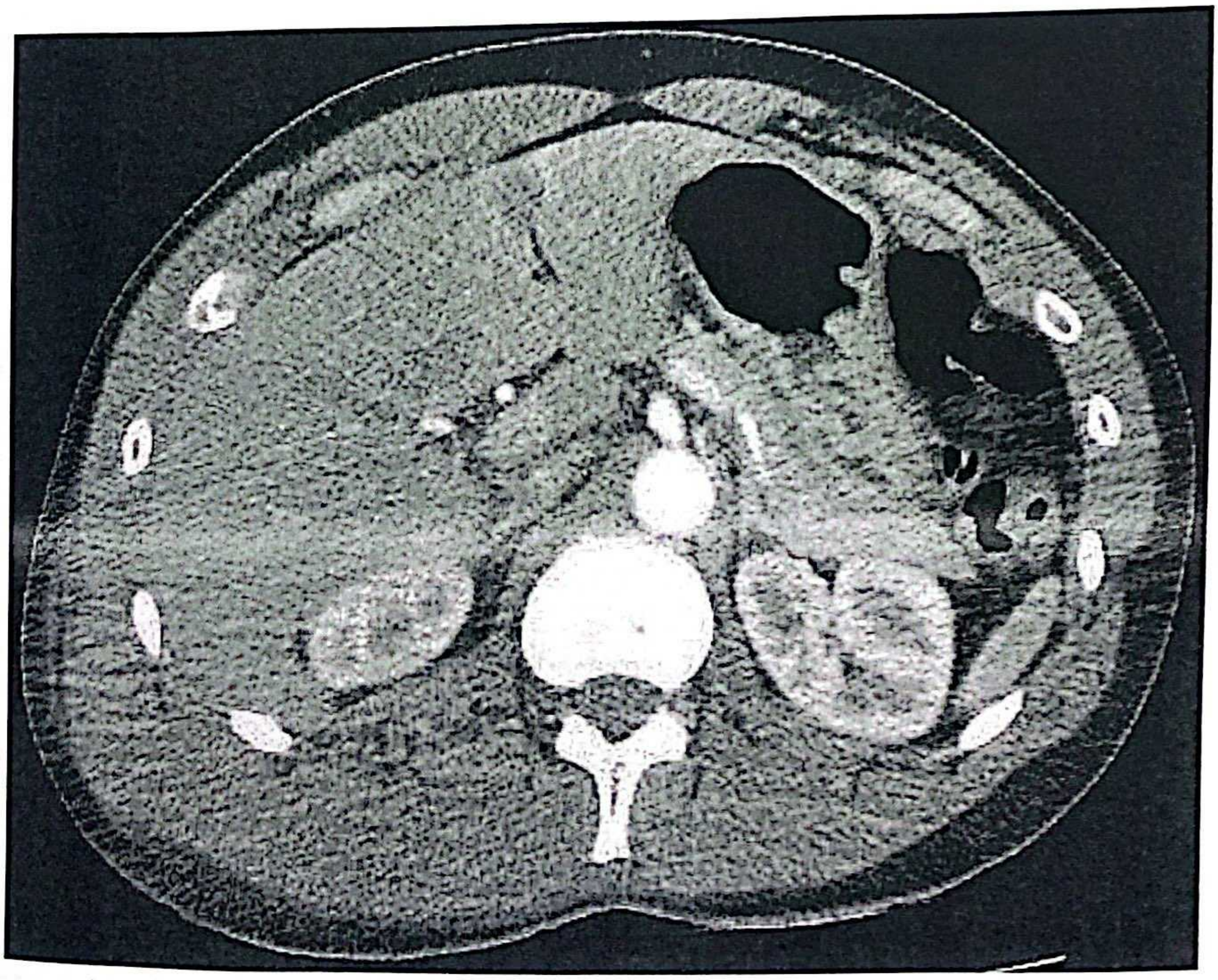
Laceration
Capsular tear >3 cm parenchymal depth




Grade I
Haematoma
Subcapsular: <10% surface area

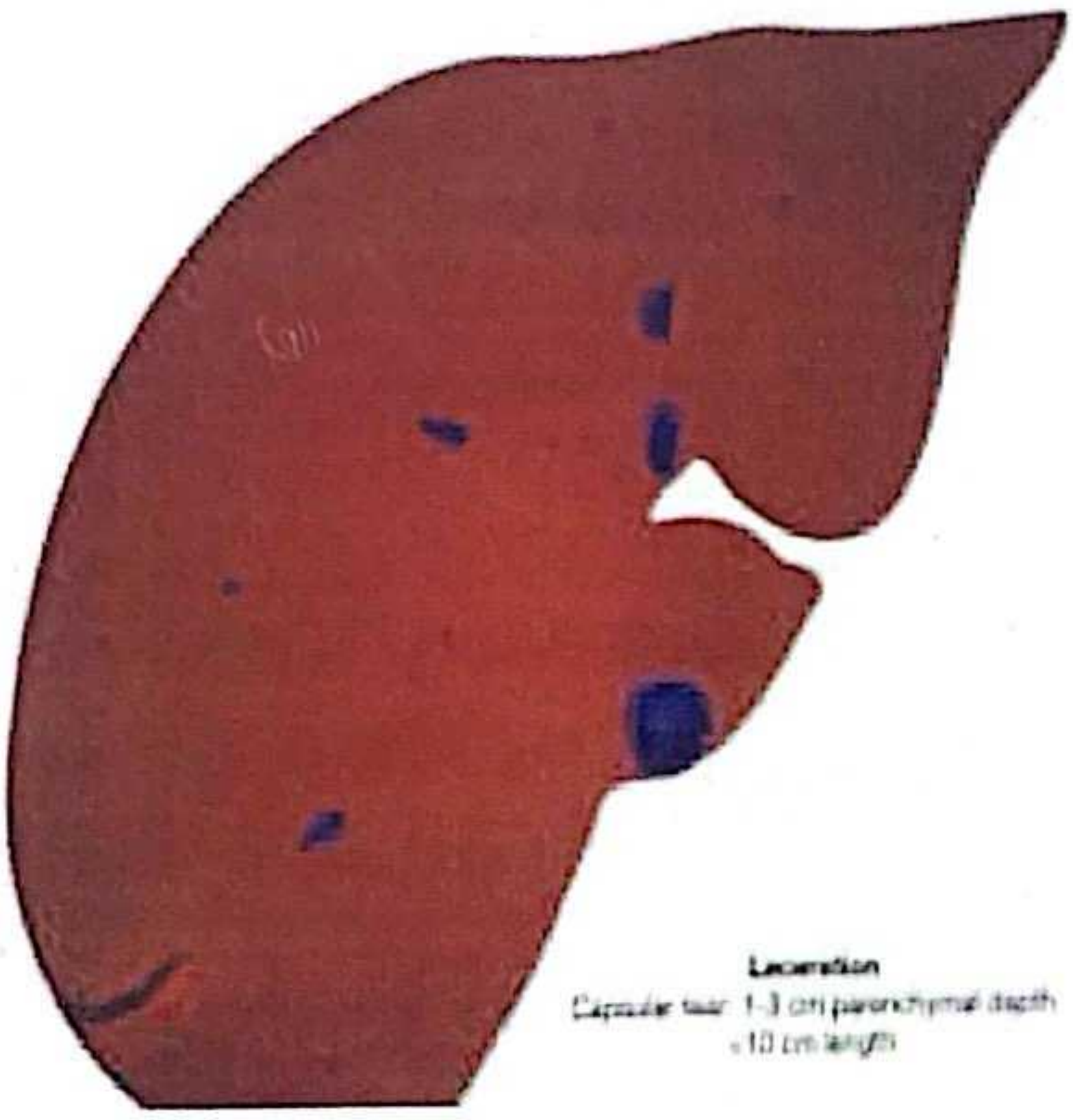

Grade I
Laceration
Capsular tear: <1 cm parenchymal depth

Liver (segment 7) subcapsular area, measuring 6mm in depth. It has HU density of 55, in keeping with haematoma.

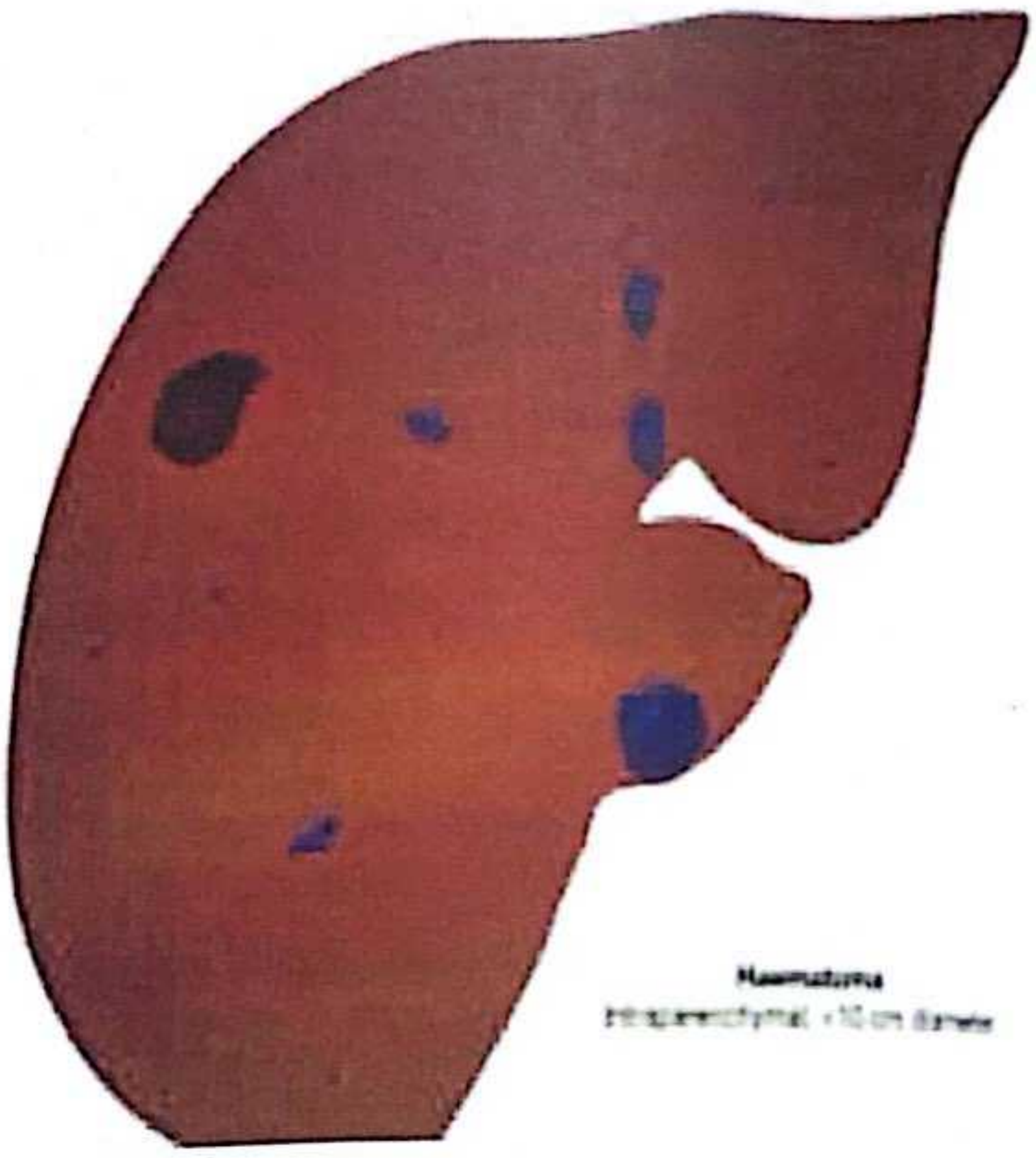


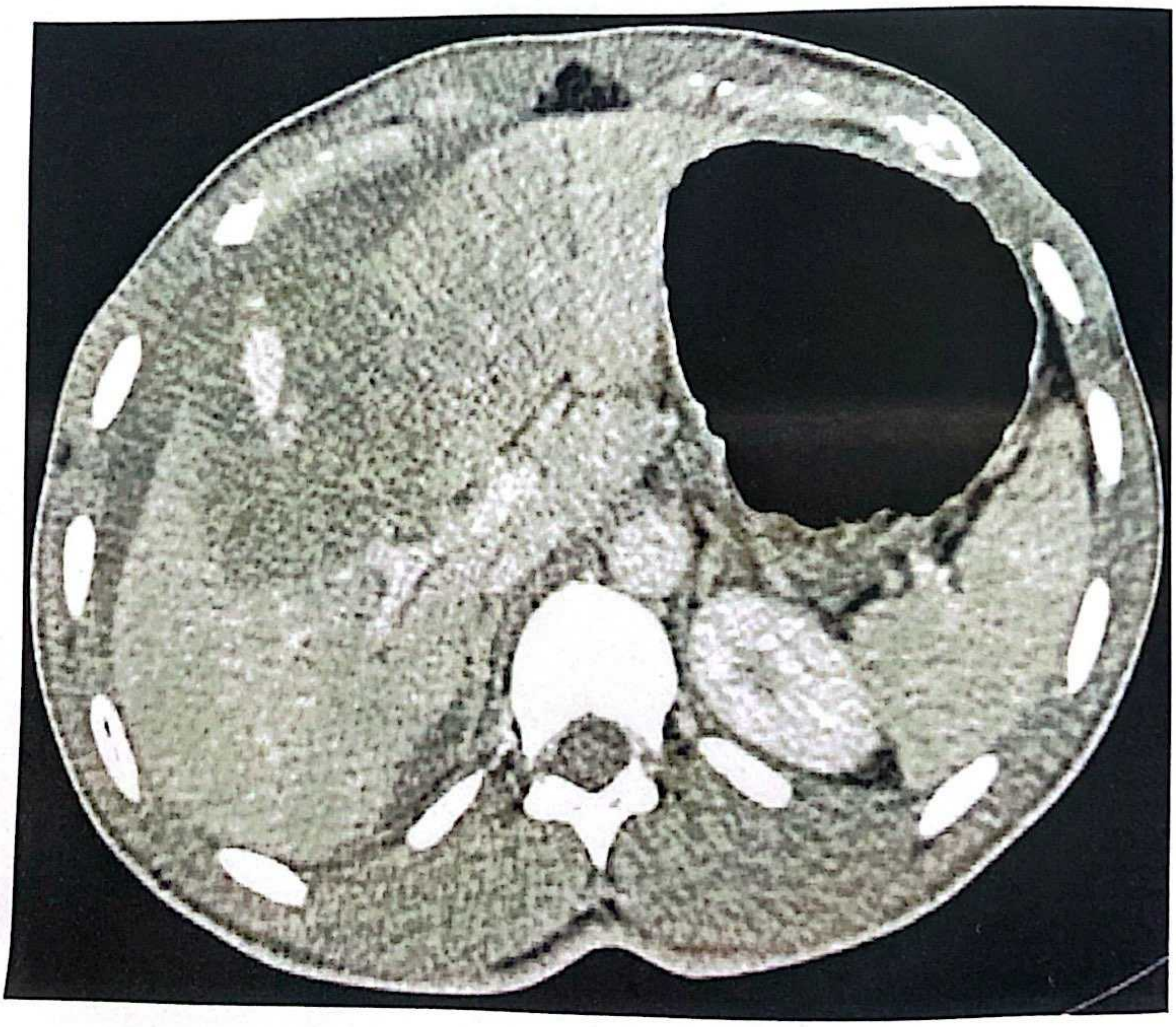
Branching low attenuation in liver extending from gallbladder fossa to segment V representing laceration/parenchymal haematoma. Similar but smaller area adjacent to falciform ligament.

Grade II


Laceration
Capsular tear 1-3 cm parenchymal depth
<10 cm length

Grade II

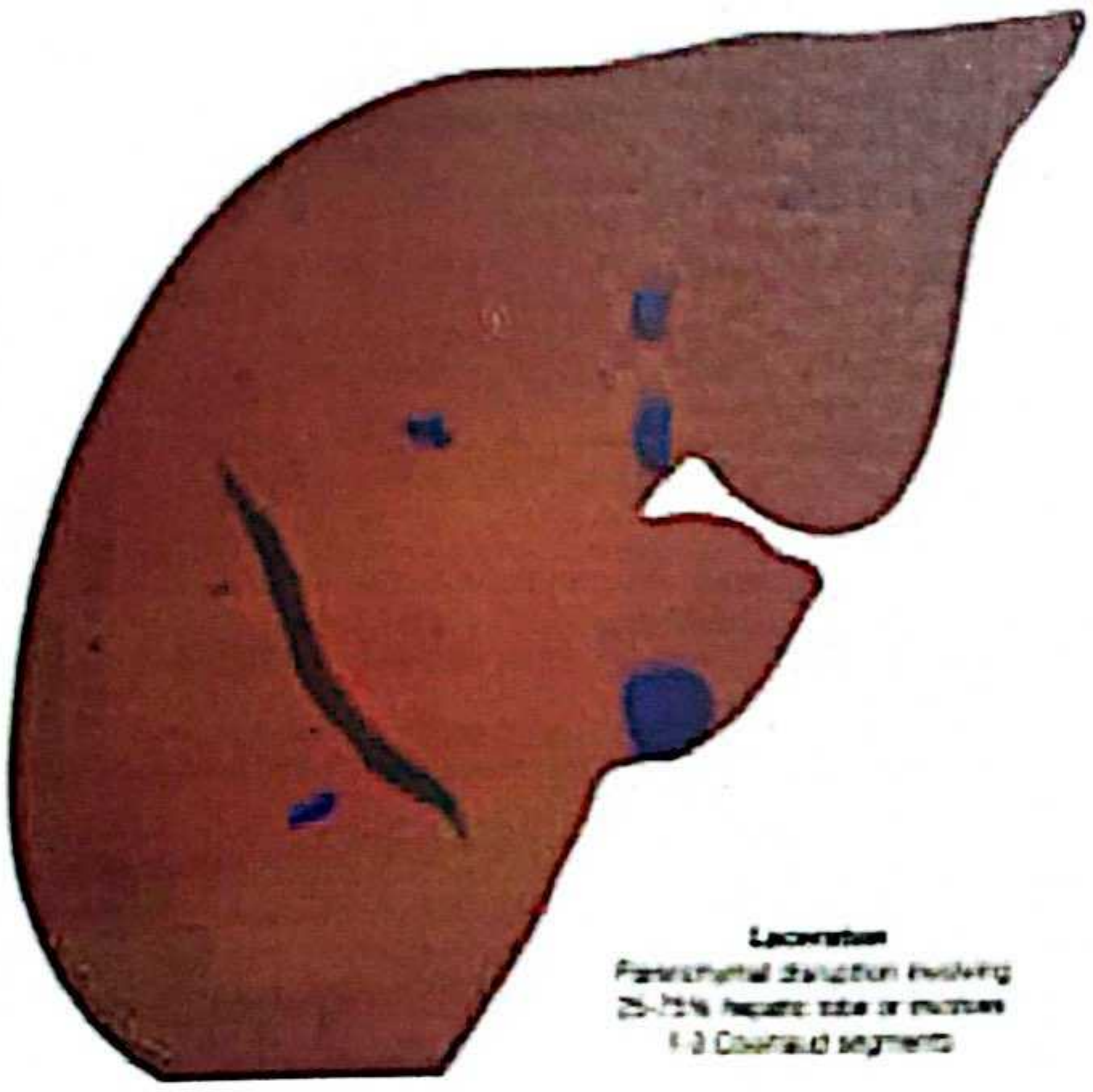

Haematoma
Intraparenchymal <10 cm diameter



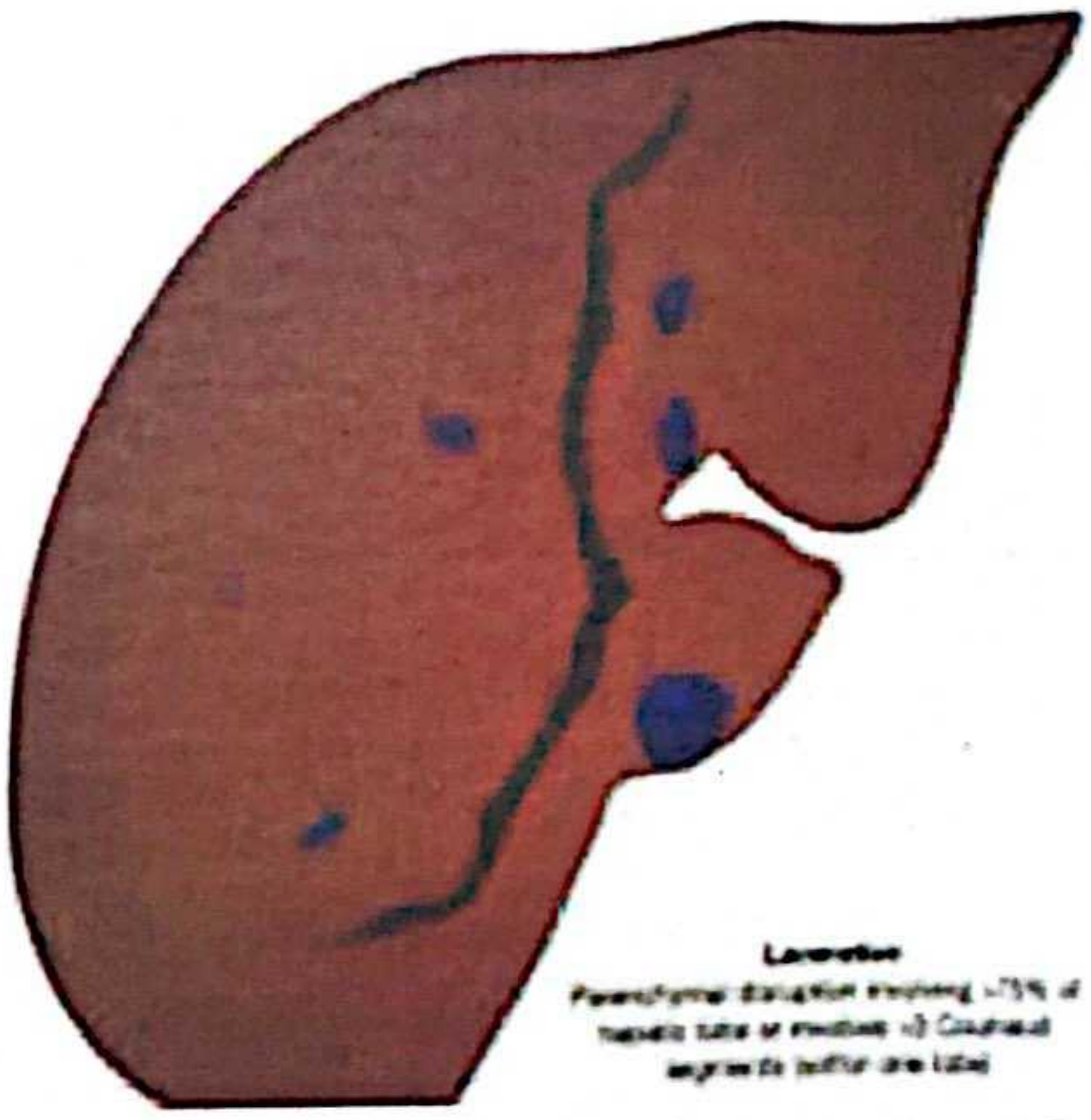
Large laceration in the right lobe of the liver with a perihepatic haematoma.

Active contrast extravastation from the liver parenchyma into the perihepatic space

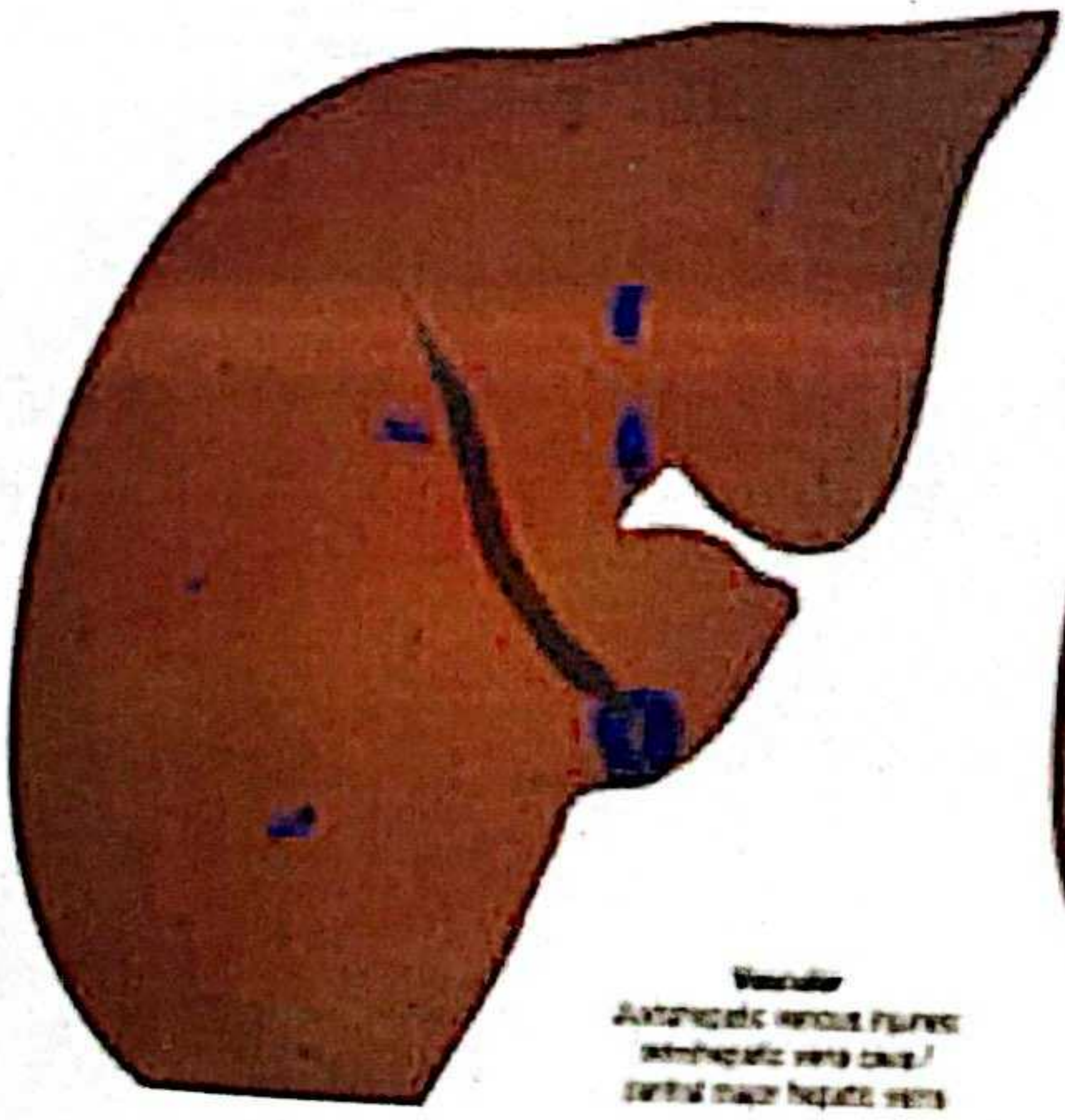
Grade IV


Laceration
Parenchymal disruption involving
25-75% hepatic lobe or involves
1-3 Couinaud segments

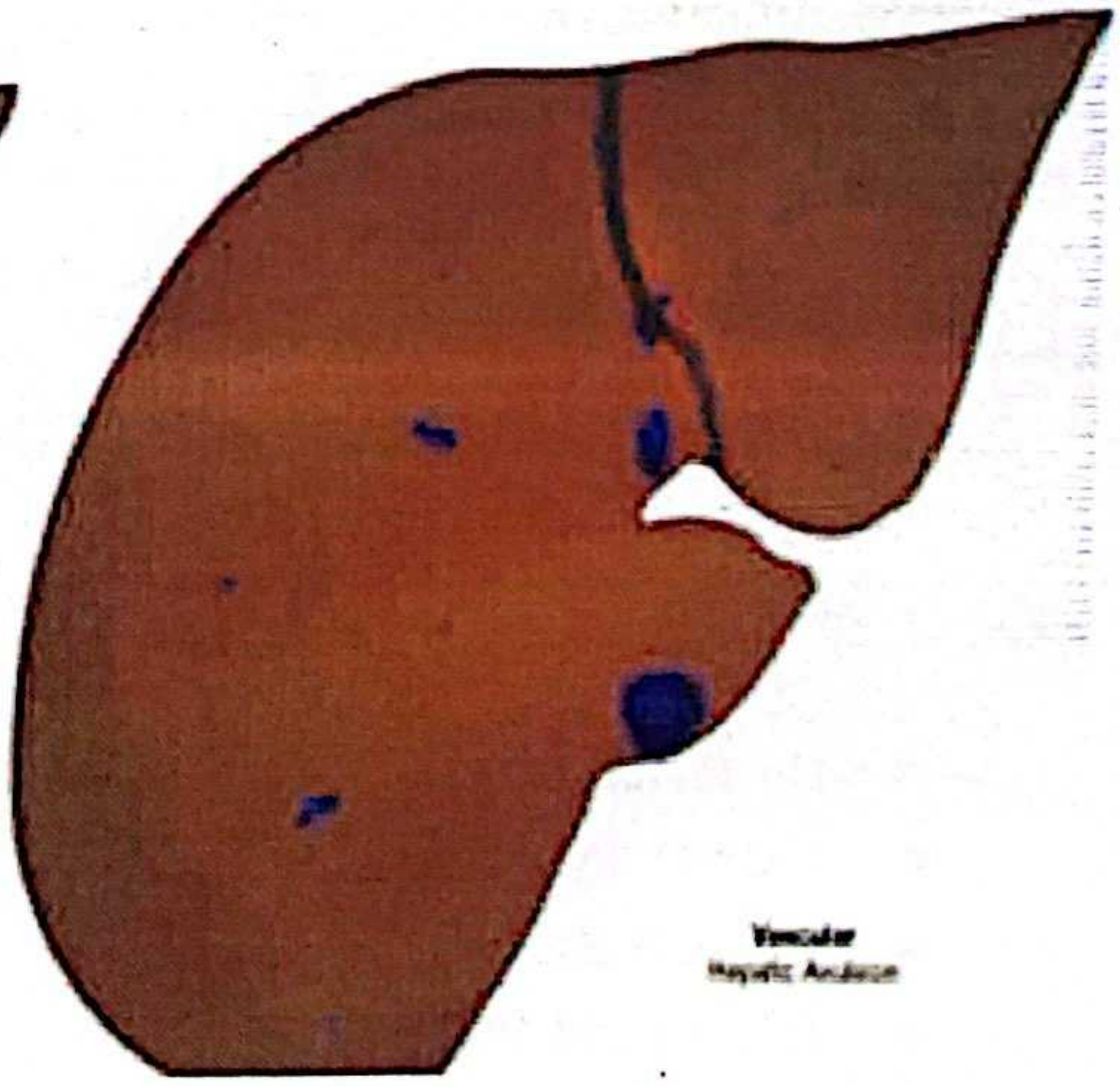
Grade V


Laceration
Parenchymal disruption involving >75% of
hepatic lobe or involves >3 Couinaud
segments within one lobe

Grade V

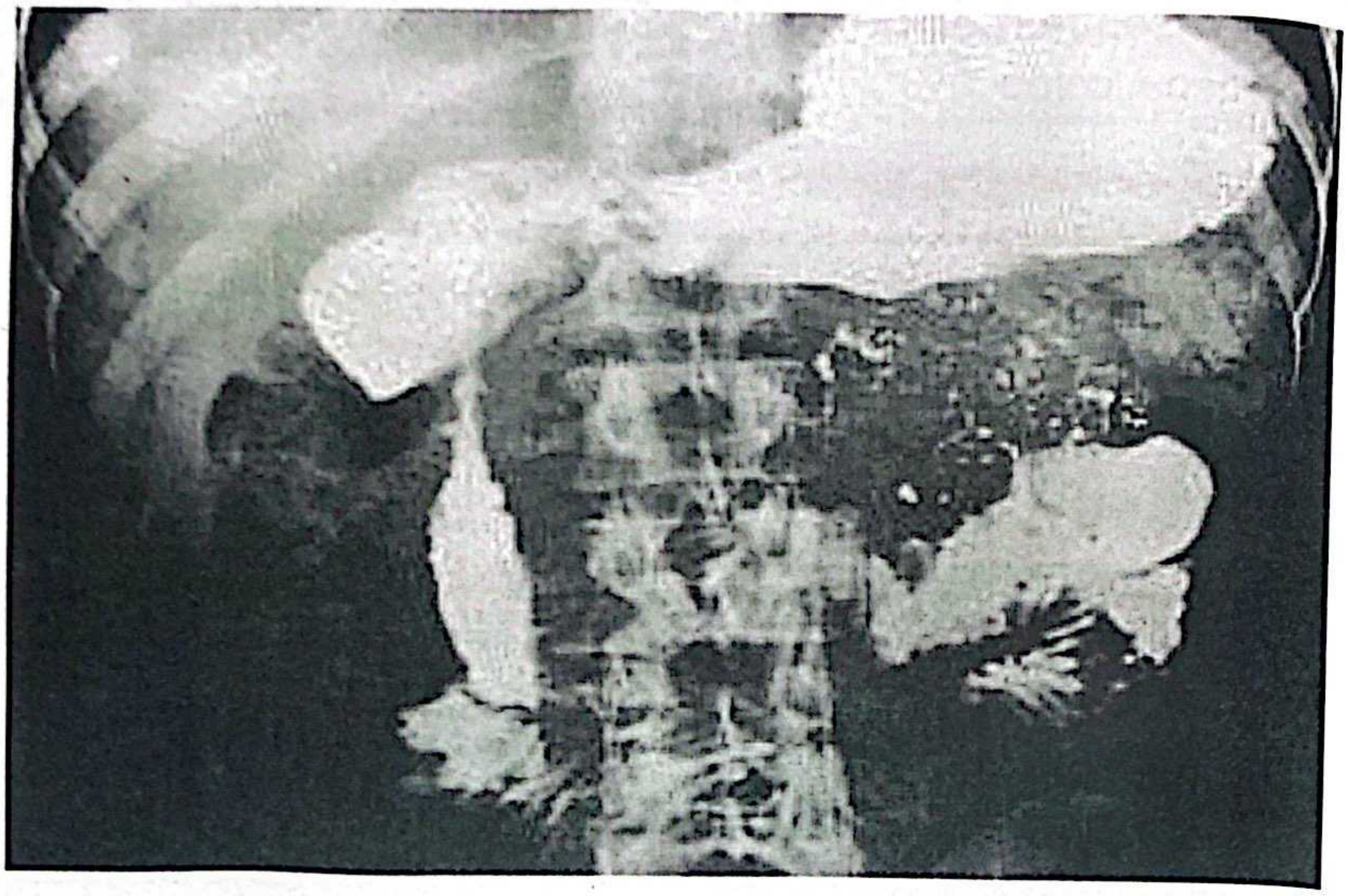

Vascular
Juxtahepatic venous injuries
retrohepatic vena cava /
central major hepatic veins

Grade VI


Vascular
Hepatic Avulsion

Q.7) c/o lower abdominal pain for 12 days with vomiting. AGE: 50-Male

(2014)



Identify: Barium follow through AP Projection
Describe: Duodenal narrowing of 2nd part of duodenum and dilatation of proximal duodenum is seen
Diagnosis: Annular pancreas
What next: Ultrasound

CT

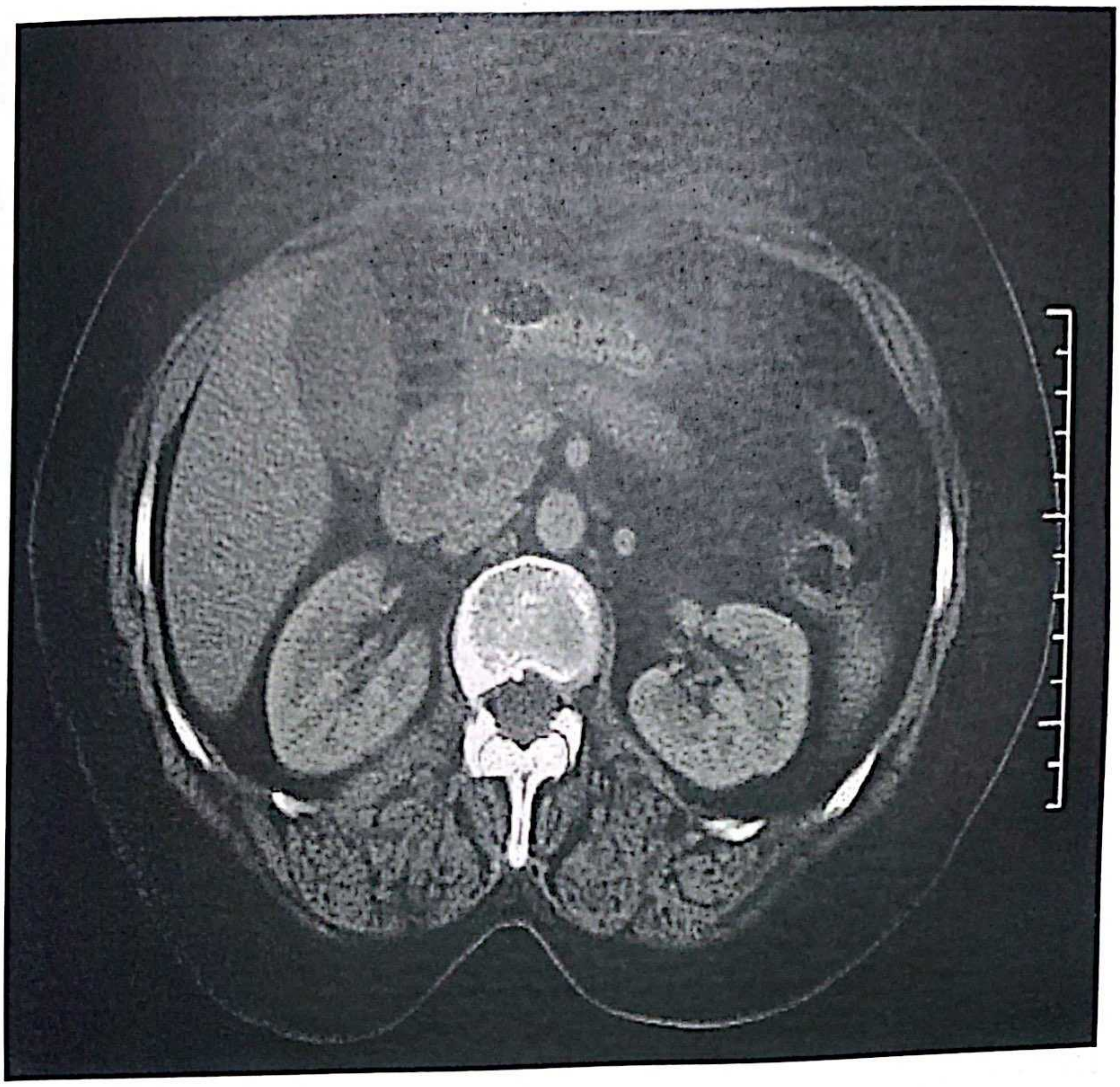
Pancreatic tissue is seen to completely or incompletely surround the 2nd part of duodenum. Associated duodenal narrowing and dilatation of proximal duodenum may also be seen. In adults, it is frequently presented with pancreatitis.

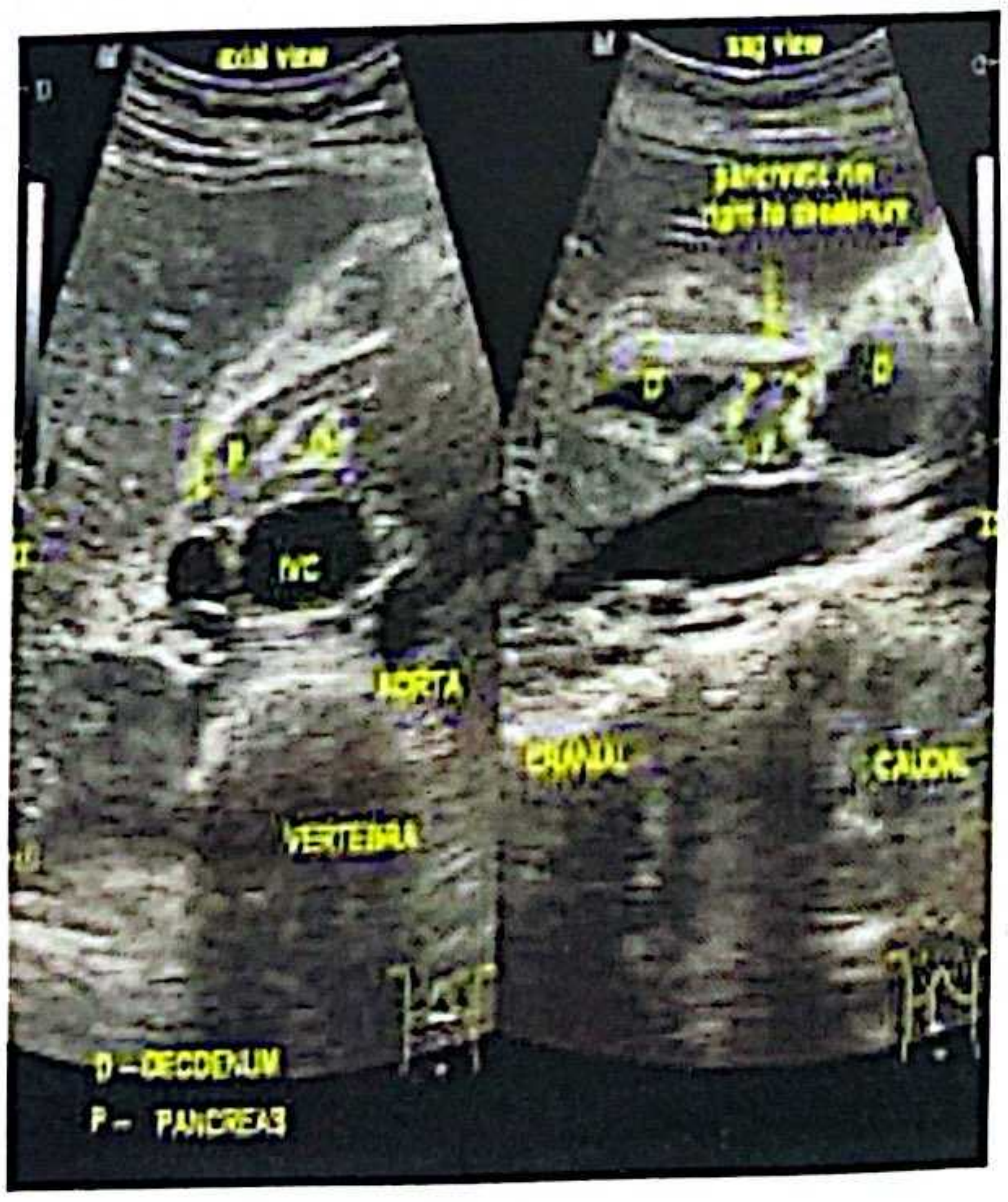
MRI/MRCP

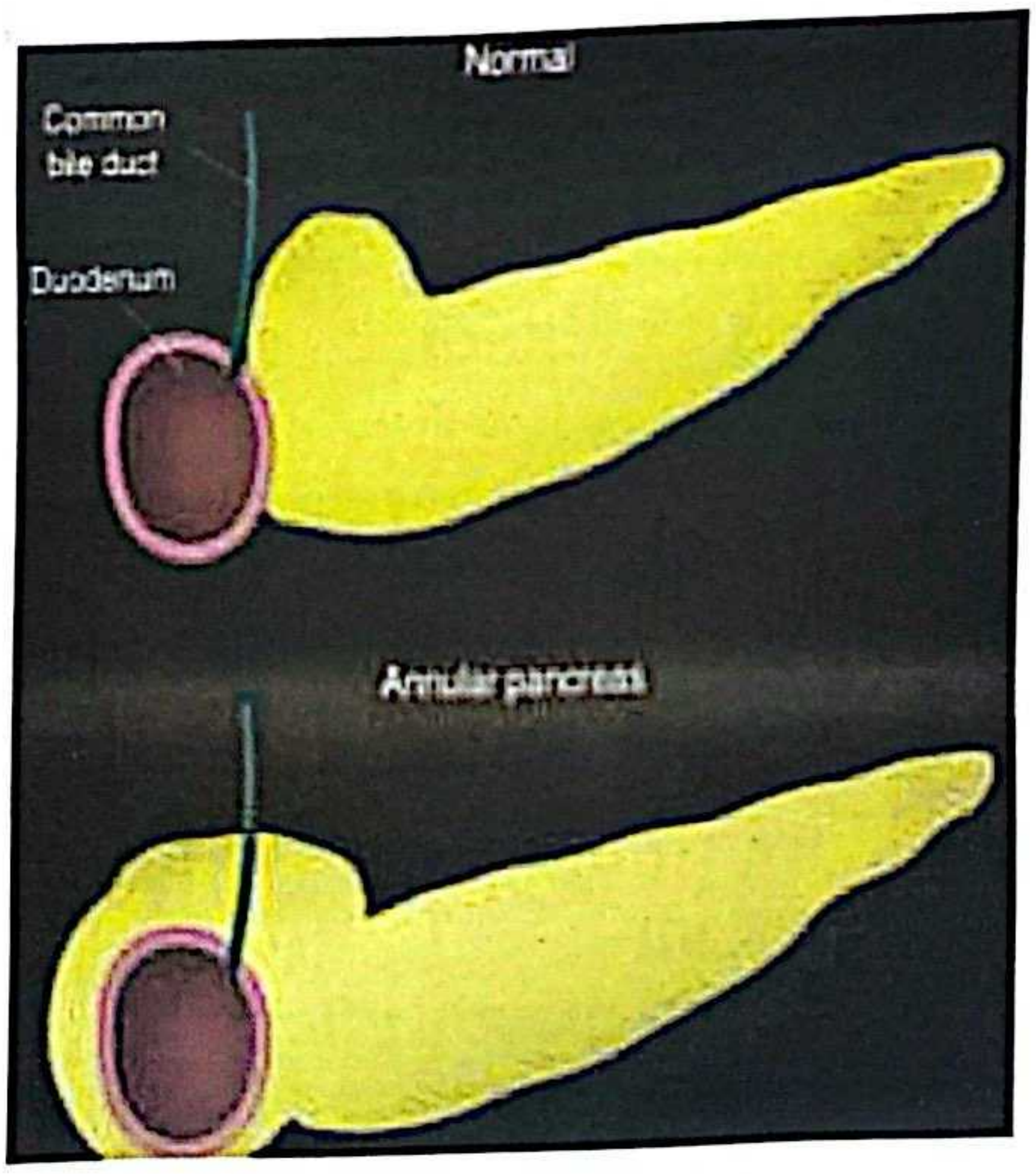
Apart from annular pancreas features, pancreatic ductal anatomy can be well assessed with MR imaging. Annular duct usually joins the main pancreatic duct or accessory duct (duct of Santorini).

Associations

- Down syndrome
- pancreas divisum
- pancreatitis
- pancreatic cancer
- intraductal papillary mucinous neoplasm (IPMN)

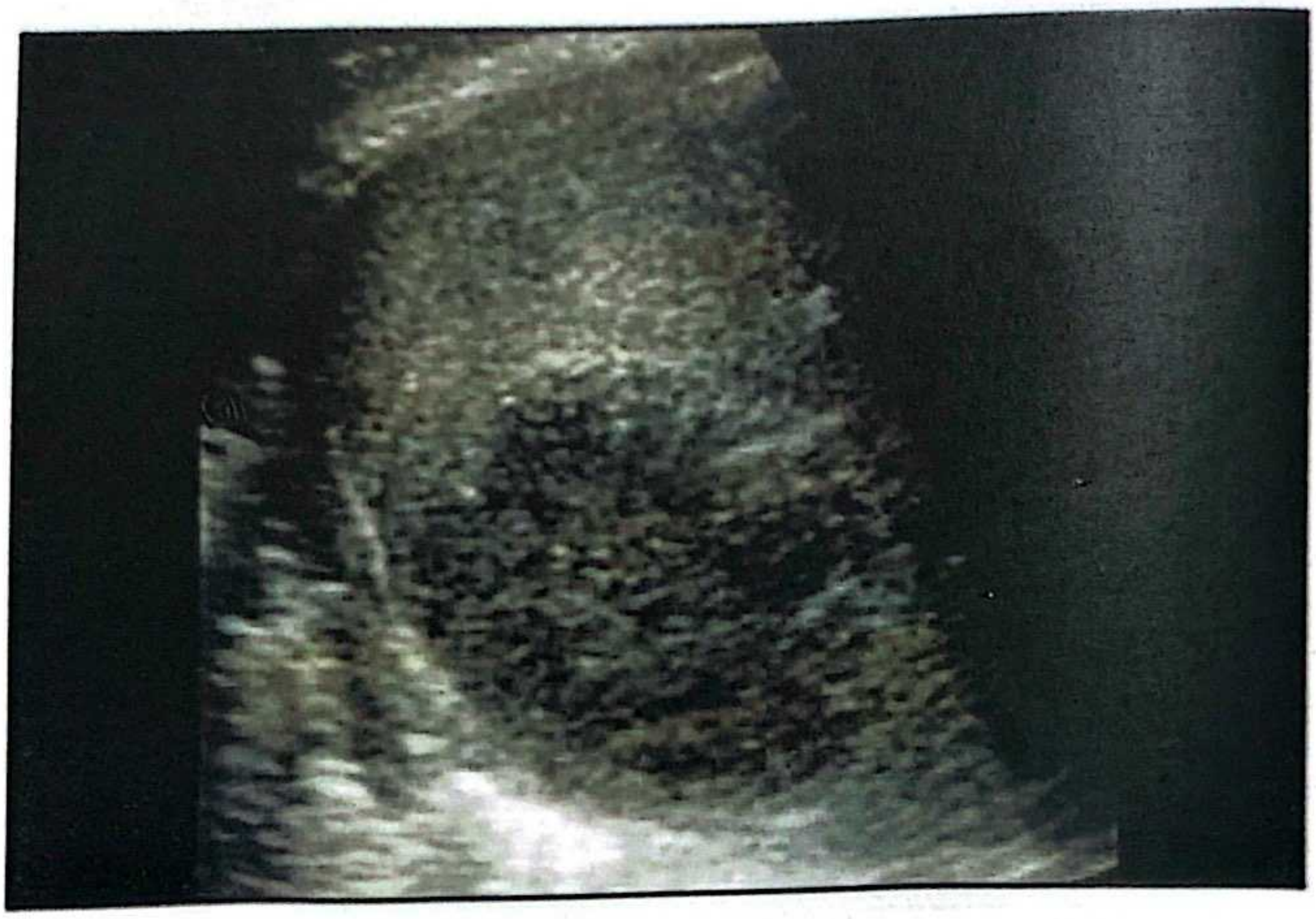



axial view
sag view
pancreatic rim right to duodenum
D
P
D
D
IVC
AORTA
VERTEBRA
CRANIAL
CAUDAL
D – DUODENUM
P – PANCREAS


Normal
Common bile duct
Duodenum
Annular pancreas

Q.8) 42-year-old male with recent trip to Thailand. He presents with fever, malaise and right upper hemiabdomen pain-AGE: 40-Male

(2014)



Identify: Gray scale ultrasound image of liver

Describe: Well defined thick walled (absence of significant wall echoes) rounded cystic lesion in **right lobe of the liver** (Segment VI-VII) with internal irregular margins, thin septae and low-level echoes.

Diagnosis: Amoebic hepatic abscess

Differential diagnoses include:

- pyogenic liver abscess
- infected hydatic or other liver cysts

Plain radiograph

A plain abdominal radiograph is not sensitive for evaluating liver abscesses. Indirect signs visible include:

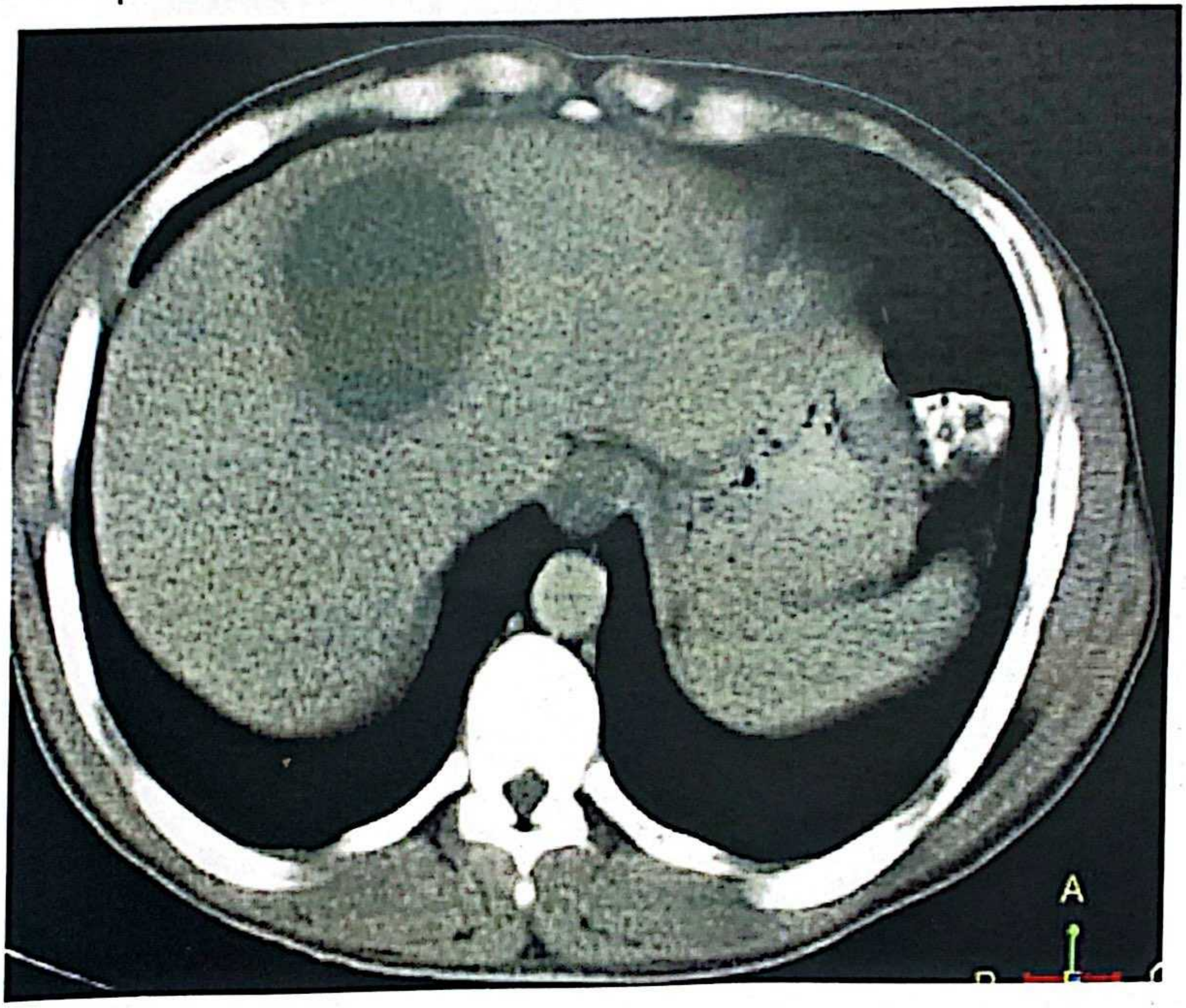
gas within the abscess or biliary tree (pneumobilia) or beneath the diaphragm

right-sided pleural effusion

What next:

CT

Usually appear as rounded, well-defined lesions with attenuation values that indicate the presence of complex fluid (e.g. 10–20 HU). An enhancing wall and a peripheral zone of oedema may be seen with wall thickness around 3-15 mm. The central abscess cavity can show septations and/or fluid-debris levels. Gas can be present within an abscess if there is a complicating hepatobronchial fistula or a hepatocolic fistula.



MRI

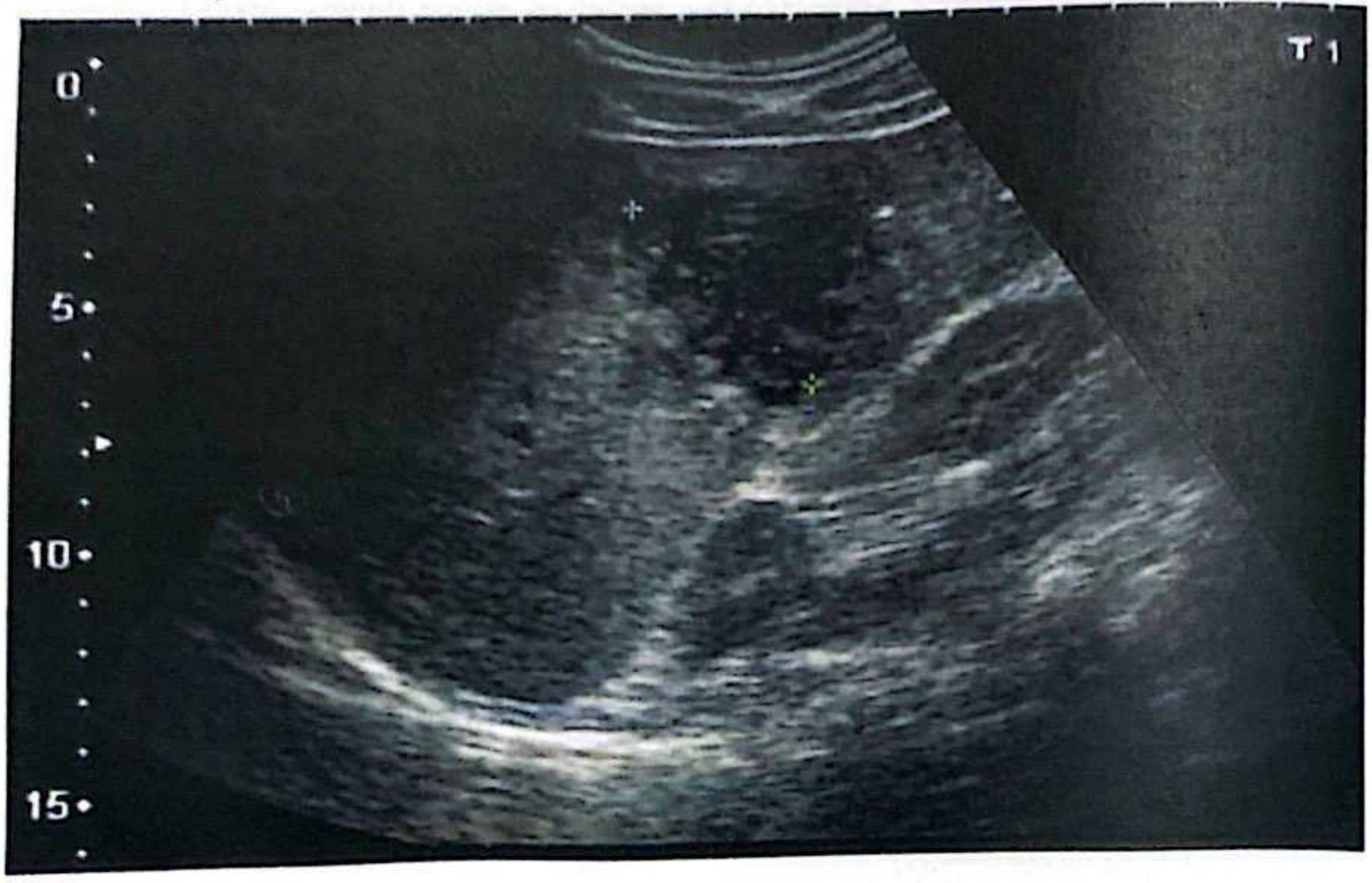
T1: generally homogeneous low signal intensity (signal homogeneity within the abscess can be present more often on T1- than on T2-weighted images 5)

T2: generally homogeneous high signal intensity; perilesional oedema may be seen in half of the cases

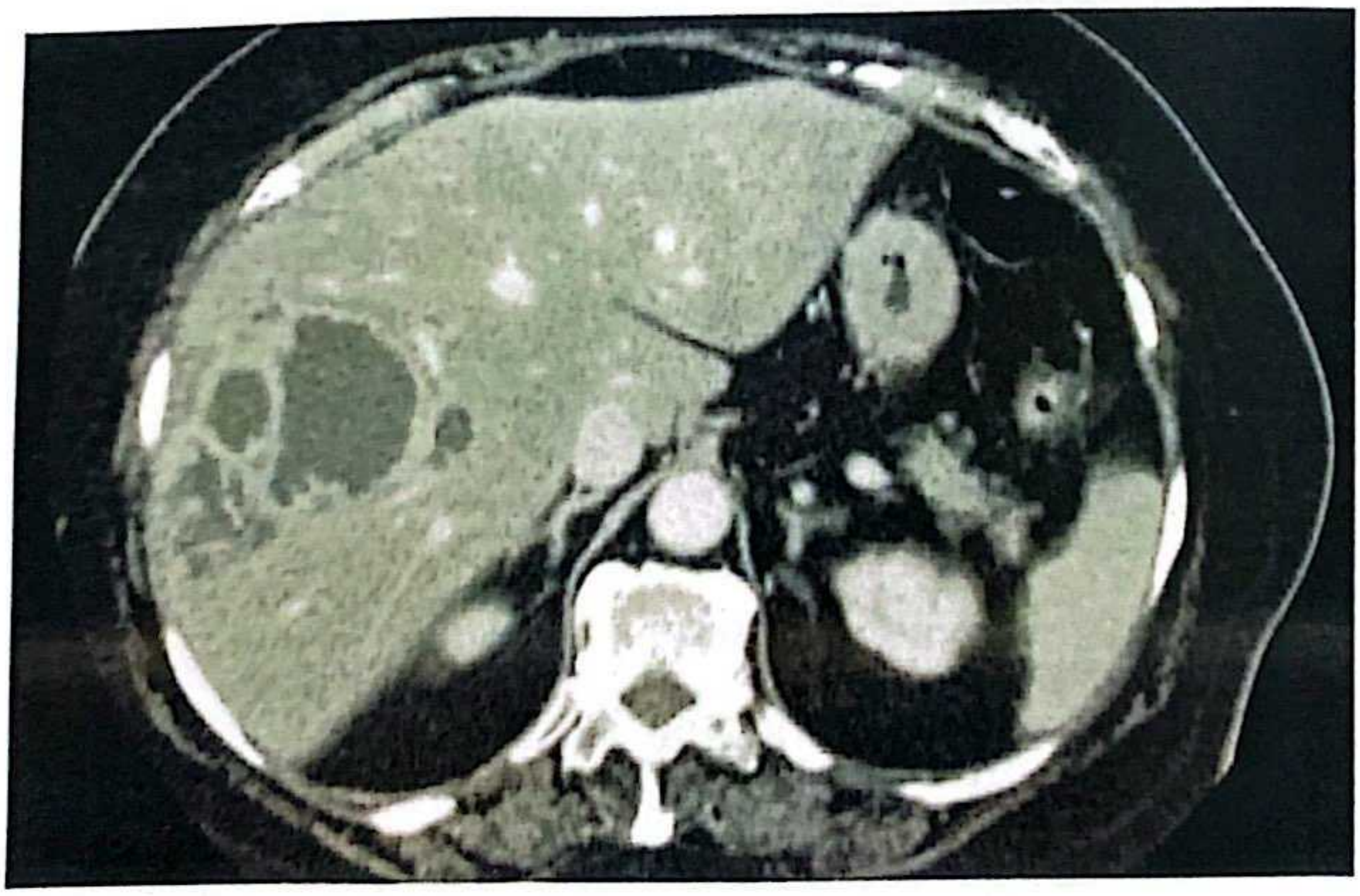
Treatment and prognosis

Management centres on initiating anti-parasitic agents, most commonly metronidazole which also treats amoebic dysentery. Traditionally, amoebic abscesses are treated with medical therapy as the first line as opposed to percutaneous or surgical drainage, which is the first line of treatment in pyogenic liver abscesses.

In practice, percutaneous drainage may frequently be required, particularly in larger abscesses which are at risk of spontaneous rupture into the peritoneal, pleural, or pericardial spaces.

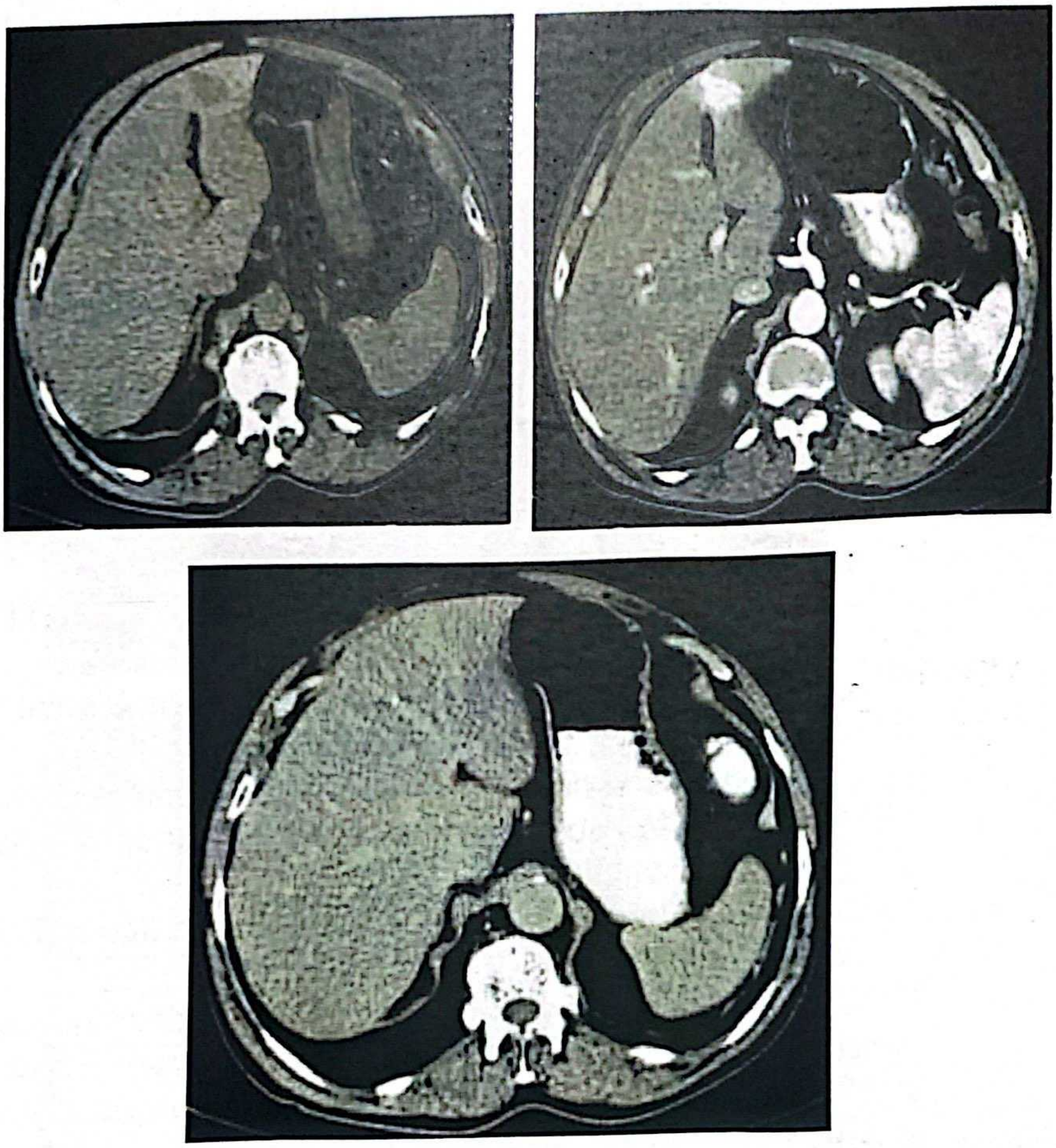


Aggregation of multiple low echos liver lesions in a localised area of **left lobe of liver**



CT demonstrates a large irregular fluid-density lesion within the right lobe of the liver with rim enhancement (inner rim) and a thin outer ring of hypoattenuation ("double target sign"). There are multiple smaller peripheral lesions with similar characteristics. Some of these appear coalescent forming "cluster sign". **This is the typical appearance for a pyogenic liver abscess.**

Q.9) Patient came for evaluation of a chronic PUJ obstruction-AGE: 80-Male (2013)



Identify: CT Abdomen Triphasic (Unenhanced, Contrast enhanced Arterial & Delayed phases Axial Section Images)

Describe: A small hypodense lesion seen in the left lobe of liver in unenhanced image

On Contrast enhanced arterial phase the hepatic lesion shows bright and complete enhancement

On Contrast enhanced delayed the hepatic lesion is noted to be of similar density as the blood pool/Arterial phase.

Diagnosis: Features are suggestive of flash filling hemangioma

What next: MRI

T1: hypointense

T2: markedly hyperintense

C+ (Gd): prompt enhancement but no washout

Other general features

At times the venous matrix of these hemangiomas may develop phleboliths, which when recognized should be promptly associated with hemangioma.

Differential diagnosis

- hepatocellular carcinoma
- hypervascular hepatic metastases (renal cell carcinoma, thyroid carcinoma, neuroendocrine tumour, choriocarcinoma, melanoma, breast carcinoma and leiomyosarcoma)
- focal nodular hyperplasia

Enhancement patterns:

- **Type 1** = immediate uniform enhancement ("flash filling"); in 42% of hemangiomas <1cm
  DDx: hypervascular tumor (does not remain hyper attenuated on delayed phase)
- **Type 2** = peripheral nodular enhancement+ complete fill-in on delayed images 3-30 min post IV bolus (in 55-89%):
  DDx: metastasis (nodular I rim enhancement ±centripetal fill-in possible)
- **Type 3** = peripheral nodular enhancement + partial (24%) I no (2%) fill-in to isodensity on delayed phase in giant hemangioma >5cm (due to thrombosis)
- **Central scar in large lesion may not enhance at any time**

Angio (historical gold standard):

- Dense opacification of well-circumscribed, dilated, irregular, punctate vascular lakes I puddles **("cotton wool I snowy tree" appearance)** in late arterial + capillary phase starting at periphery in ring- I C-shaped configuration
- Normal-sized feeders; AV shunting (very rare)
- Contrast persistence late into venous phase

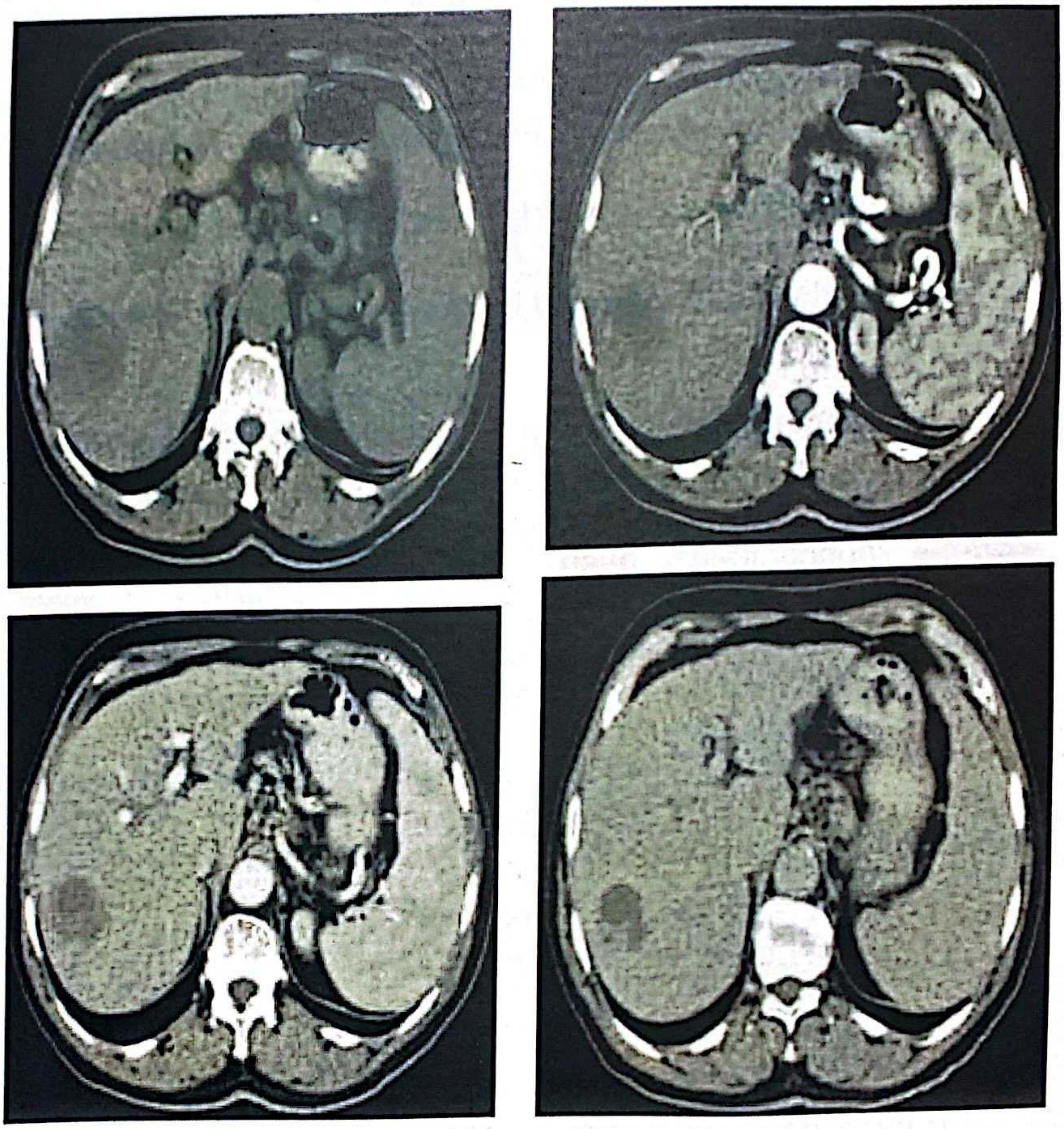
NUC (95% accuracy with SPECT):

Indication:

- Lesions >2cm (detectable in 70-90%) with atypical imaging characteristics on crosssectional imaging
- Initially cold lesion on Tc-99m labeled RBC scans (dose of 15-20 mCi) with increased activity on delayed images at 1-2 hr
- Cold defect on sulfur colloid scans

Q.10) Incidentally discovered hepatic mass on ultrasound- AGE: 70 years-Male

(2014)



Identify: CT Abdomen Triphasic/Quad Phase (Unenhanced, Contrast enhanced Arterial, Venous & Delayed phases Axial Section Images)

Describe: Right hepatic lobe mass with continuous faint nodular wash in of contrast in a centripetal manner. Most of the hemangiomas become filled with contrast on delayed phase, however, this lesion did not fill in completely may be due to the larger size of the lesion. The lesion became "smaller" on the delayed phase if compared to the pre-contrast phase.

Diagnosis: Features are suggestive of Hepatic haemangioma

Ultrasound

- Typically, well-defined hyperechoic lesions
- a small proportion (10%) are hypoechoic, which may be due to a background of hepatic steatosis, where liver parenchyma itself is of increased echogenicity
- colour Doppler: may show peripheral feeding vessels

Contrast-enhanced ultrasound

- Arterial phase: peripheral nodular discontinuous enhancement
- Portal venous and delayed phases: continued "filling in" of the lesion, until the entire haemangioma is hyperechoic relative to background liver

CT

Most haemangiomas are relatively well defined. The dynamic enhancement pattern is related to the size of its vascular space. Features of typical lesions include:

- noncontrast: often hypoattenuating relative to liver parenchyma
- arterial phase: typically show discontinuous, nodular, peripheral enhancement (small lesions may show uniform enhancement)
- portal venous phase: progressive peripheral enhancement with more centripetal fill-in
- delayed phase: further irregular fill-in and therefore iso- or hyper-attenuating to liver parenchyma

Other described features include:

- bright dot sign

MRI

T1: hypointense relative to liver parenchyma

T2: hyperintense relative to liver parenchyma, but less than the intensity of CSF or of a hepatic cyst

T1 C + (Gd): often shows peripheral nodular discontinuous enhancement which progresses centripetally (inward) on delayed images

haemangiomas tend to retain contrast on delayed (>5 minutes) contrast-enhanced images

- atypical haemangiomas may demonstrate slightly altered enhancement patterns

T1 C + (hepatobiliary contrast, Eovist):

in general, delayed imaging with Eovist/Gd- BOPTA may not be helpful since haemangiomas can have a variable appearance that ranges from hypointensity to diffuse and central enhancement
DWI: hyperintense on diffusion-weighted imaging (DWI) even with high b-values due to slow blood flow and may be hyperintense or mixed (hyper and hypointense regions) on ADC map 16

Nuclear medicine

SPECT

99Tc RBC labelled SPECT can be sensitive for larger lesions and typically demonstrate decreased activity on initial dynamic images followed by increased activity on delayed, blood pool images.

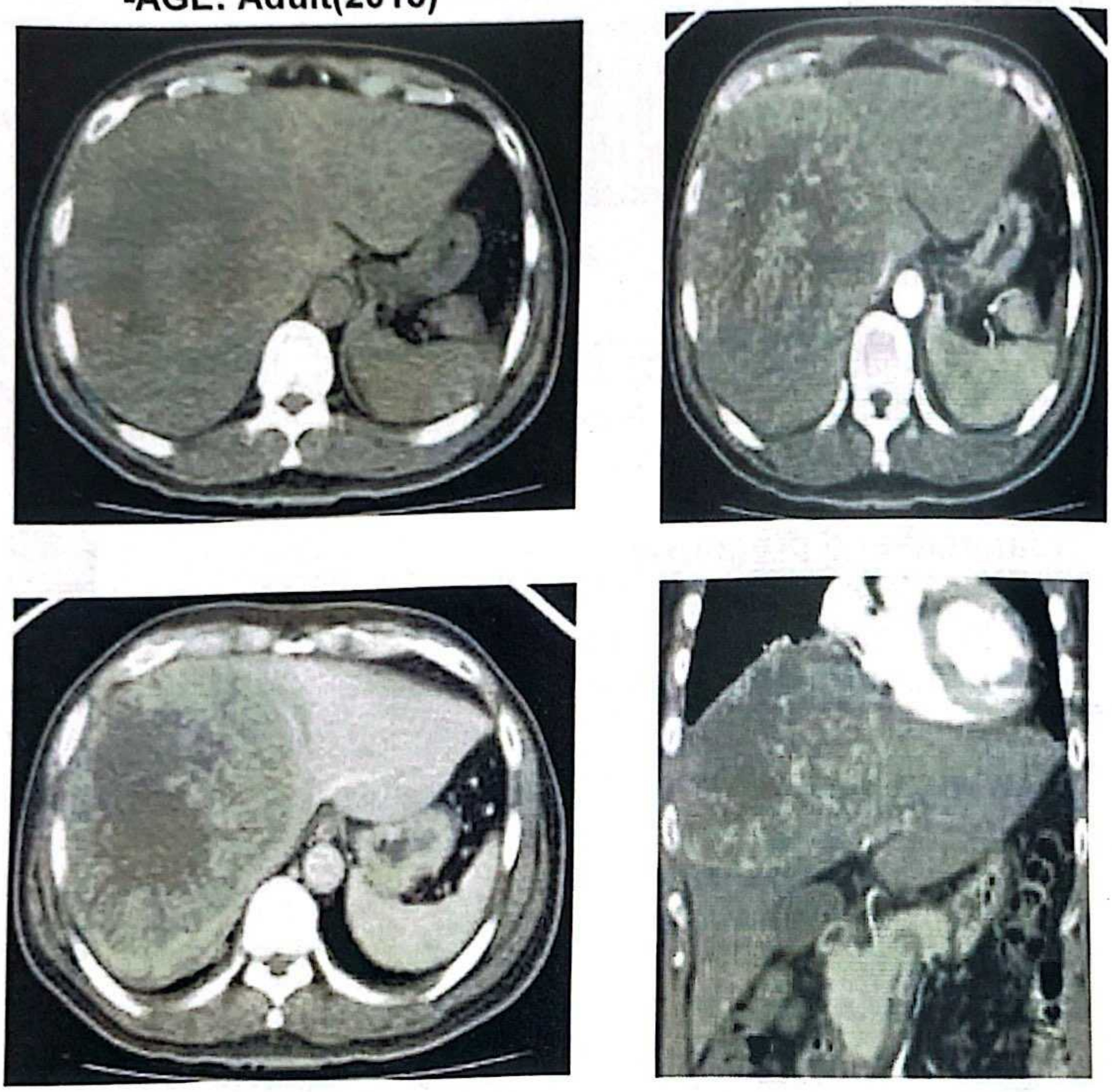
Treatment and prognosis

They are benign lesions. Recommendations for patients with no known risk factors for hepatic malignancy can range from centre to centre from performing confirmatory examinations (MR imaging, triphasic CT or scintigraphy) to considering follow-up ultrasound in 6 months to confirm stability, to performing no further imaging evaluation 13. Some authors propose surgical resection for patients with progressive abdominal pain in combination with size greater than 5 cm 14.

Differential diagnosis

- hepatic metastases
- hypervascular hepatic metastases show marked early enhancement with a continuous ring that on later images fills in centrally and progressive centripetal fill-in may occur on delayed phases
- hepatocellular carcinoma
- hepatic cyst
- hepatic abscess
- regenerative nodules / dysplastic nodules
- cystic hepatic or biliary neoplasm
- haemangioendothelioma

Q.11) Hepatitis C. Worsening liver function tests and jaundice- -AGE: Adult(2013)



Identify: CT Abdomen Triphasic (Unenhanced, Contrast enhanced Arterial, Venous & Delayed phases Axial Section Images)

Describe: Large heterogenous soft tissue mass in the superior aspect of the right lobe of the liver, with a well circumscribed but irregular border. The mass shows heterogenous peripheral and central enhancement and contains a central area of hypoattenuation consistent with a necrotic core. There is early washout as the lesion is hypodense on portal venous phase imaging.

There is no evidence of local metastasis. The portal and hepatic veins are spared.

Diagnosis: Findings are consistent with focal hepatocellular carcinoma.

What next: alpha-fetoprotein (AFP) levels are elevated

CT

Usually, the mass enhances vividly during late arterial (35 seconds) and then washes out rapidly, becoming indistinct or hypoattenuating in the portal venous phase, compared to the rest of the liver.

Portal vein tumour thrombus can be distinguished from bland thrombus by demonstrating enhancement.

MRI

When seen in the setting of cirrhosis, small HCCs need to be distinguished from regenerative and dysplastic nodules

T1

- variable
- iso- or hyperintense c.f. surrounding liver
- hyperintensity may be due to
- intratumoral fat 5
- decreased intensity in surrounding liver

T1 C+ (Gd)

- enhancement is usually arterial ("hypervascularity")
- rapid "washout," becoming hypointense to the remainder of the liver (96% specific)
- this is because the supply to HCCs is predominantly from the hepatic artery rather than the portal vein
- rim enhancement may persist (referred to as a capsule)

T1 C+ (Eovist/Primovist)

similar to assessment with extracellular Gd, but evaluation of the hepatobiliary phase requires care

T2:

- variable, typically moderately hyperintense
- C+ post-SPIO (iron oxide): increases sensitivity in diagnosing small HCCs

DWI: intratumoural high signal; increases sensitivity and specificity ref required

DSA:

- angiography
- hypervascular tumour
- threads and streaks pattern: sign of tumor thrombus in portal vein

LI-RADS (Liver Imaging Reporting and Data System)

Major criteria

Hepatic phase enhancement

- hyperenhancement: enhancement in the arterial phase is definitely greater than that of background liver
- if unsure, classify as iso enhancing

Washout

- a visual assessment of relative hypointensity of the lesion compared with background liver on the portal venous and delayed phases

Capsule/pseudocapsule

peripheral rim of smooth hyperenhancement seen in the portal venous or delayed phases

Threshold growth

- diameter increase of a mass by a minimum of 5 mm
  also
- ✓ if prior exam ≤6 months, diameter ≥50% increase
- ✓ if prior exam >6 months, diameter ≥100% increase
- a new 10 mm lesion represents threshold growth, regardless of the time interval
- threshold growth only applies to masses
- threshold growth should be compared on similar sequences between studies

Ancillary features

Favoring HCC

- mild-moderate T2 hyperintensity
- restricted diffusion
- corona enhancement (rim of peri-lesional enhancement)
- mosaic architecture
- nodule-in-nodule architecture
- intralesional fat
- lesional iron sparing
- lesional fat sparing
- blood products
- diameter increase (less than threshold growth)

Favoring benignity

- homogeneous marked T2 hyperintensity
- homogeneous marked T2 or T2* hypointensity
- undistorted vessels
- parallels blood pool enhancement
- diameter reduction
- diameter stability >2 years

Classification system

Major criteria imaging findings often lead directly to the assignment of a LI-RADS score. If assignment is unclear, ancillary findings may be useful as a "tie-breaker."

The LI-RADS score ranges from L1 (favor benignity) to L5 (favor malignancy).

LR1 (100% benign)

Imaging features diagnostic of a benign entity:

- cyst
- haemangioma
- vascular anomaly
- perfusion alteration
- hypertrophic pseudomass
- confluent hepatic fibrosis
- focal scar

Definite disappearance at follow-up in the absence of treatment is also definitional of LR1

LR2 (probably benign)

Entities are similar to LR1, but the appearance is highly suggestive of the entity instead of 100% diagnostically certain

- atypical appearance of benign entities may be categorised as LR2
- LR2 cirrhosis-associated nodule is also included

LR3 (intermediate probability for HCC)

Not a definitely benign entity, but not definitely HCC

Includes entities that demonstrate

- not a definite mass
- mass with hepatic arterial phase iso- or hypoenhancement
- ❖ <20 mm with no more than one of the following:
    - ✓ "washout"
    - ✓ capsule
    - ✓ threshold growth
- ❖ ≥20 mm with no "washout," capsule, or threshold growth

mass with hepatic arterial phase hyperenhancement

- ❖ <20 mm with no "washout," capsule, or threshold growth

LR4 (probably HCC)

LR4A (<20 mm mass)

- ❖ mass with hepatic arterial phase iso- or hypoenhancement

two or more of the following

- ✓ "washout"
- ✓ capsule

- ✓ threshold growth
- ❖ mass with hepatic arterial phase hyperenhancement

<10 mm with one or more of the following

- ✓ "washout"
- ✓ capsule
- ✓ threshold growth

10-19 mm with only one of the following

"washout"

if just washout and was seen as a discrete nodule on a prior screening ultrasound, then "LR-5us")

- ✓ capsule
- ✓ threshold growth

LR4B (>20 mm mass)

- ❖ mass with hepatic arterial phase iso- or hypoenhancement

one or more of the following

- ✓ "washout"
- ✓ capsule
- ✓ threshold growth

mass with hepatic arterial phase hyperenhancement

none of the following

- ✓ "washout"
- ✓ capsule
- ✓ threshold growth

LR5 (100% definite HCC)

LR5A (10-19 mm mass)

mass with hepatic arterial phase hyperenhancement

two or more of the following

- ✓ "washout"
- ✓ capsule
- ✓ threshold growth

LR5B (>20 mm mass)

mass with hepatic arterial phase hyperenhancement

one or more of the following

- ✓ "washout"
- ✓ capsule
- ✓ threshold growth

There is a special category LR5V for HCC that is invading the portal vein. This is reported since it is a contraindication to liver transplantation.

There is also a special category for LR5 Treated, in the case of lesions that have received loco-regional therapy (e.g. TACE or thermal ablation).

Suggested management

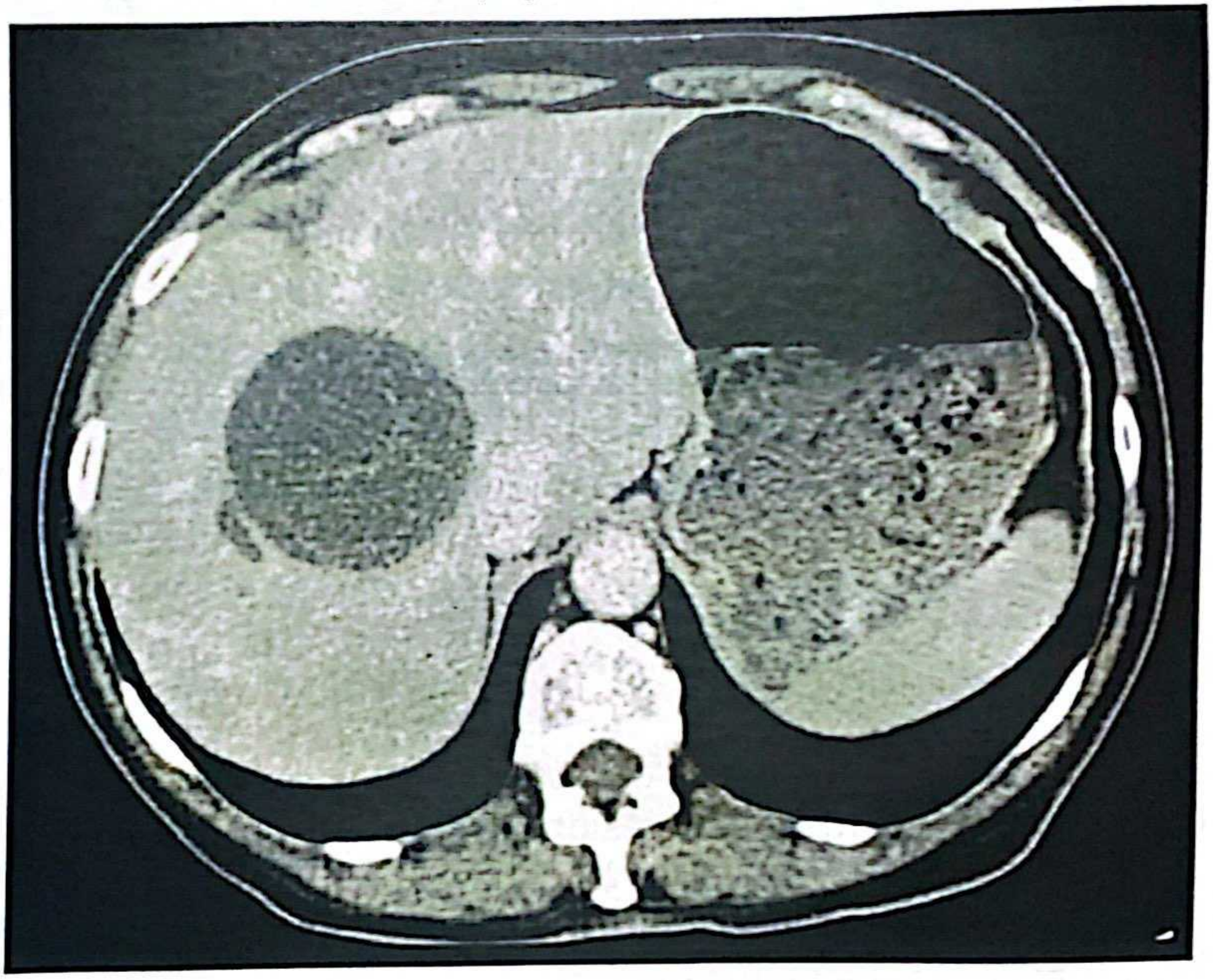
LR1: Continued routine surveillance

LR2: Continued routine surveillance

LR3: Variable follow up, depending on size, stability, and clinical presentation

LR4: Close follow-up, additional imaging, biopsy, or treatment

LR5: Treatment without biopsy, radiologic T-staging



Cystic lesion in liver with tiny foci of calcification.

Cyst classification

type I: simple cyst with no internal architecture

type II: cyst with daughter cyst(s) and matrix

type IIa: round daughter cysts at periphery

type IIb: larger, irregularly shaped daughter cysts occupying almost the entire volume of the mother cyst

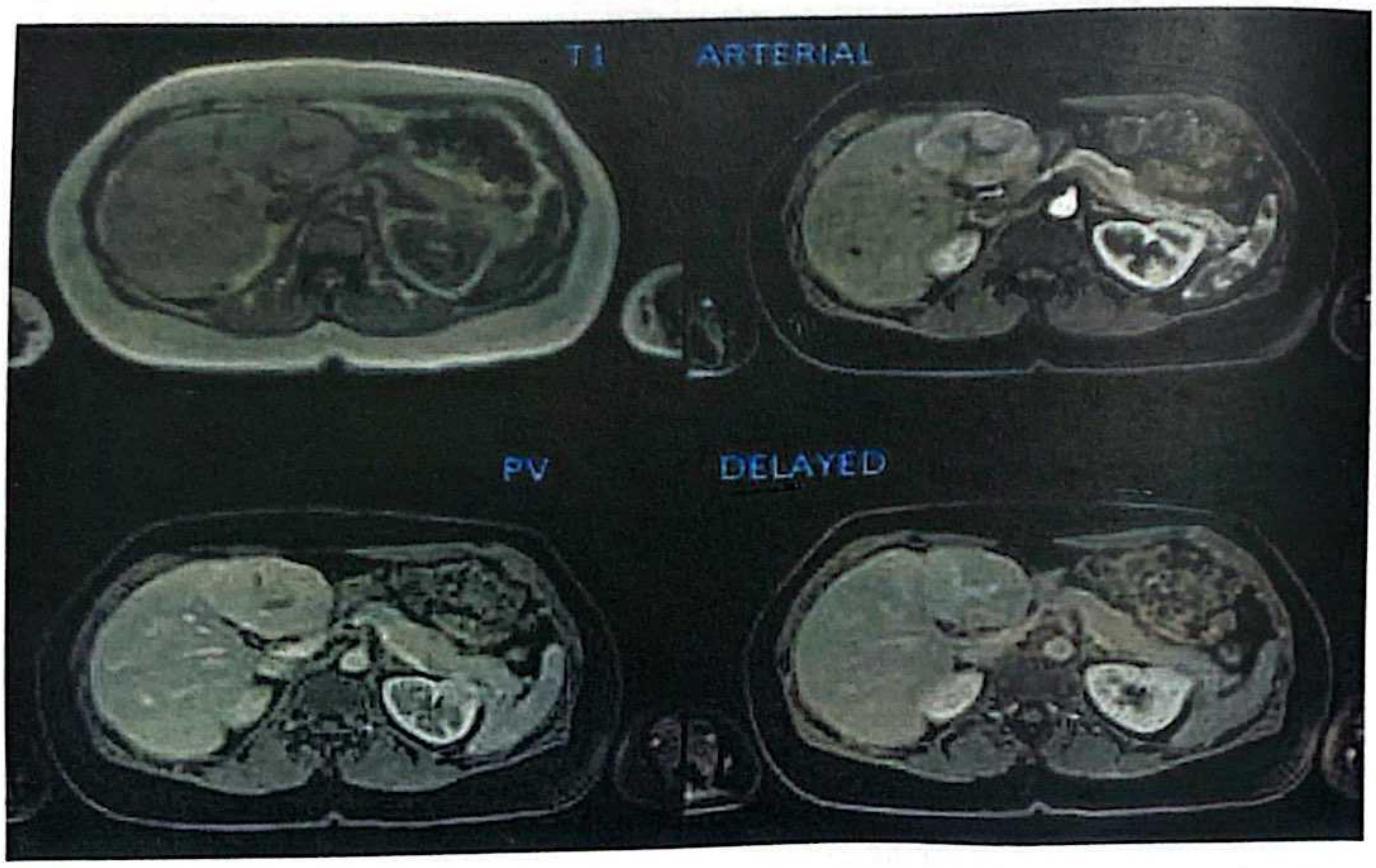
type IIc: oval masses with scattered calcifications and occasional daughter cysts

type III: calcified cyst (dead cyst)

type IV: complicated cyst, e.g. ruptured cyst

Ultrasound

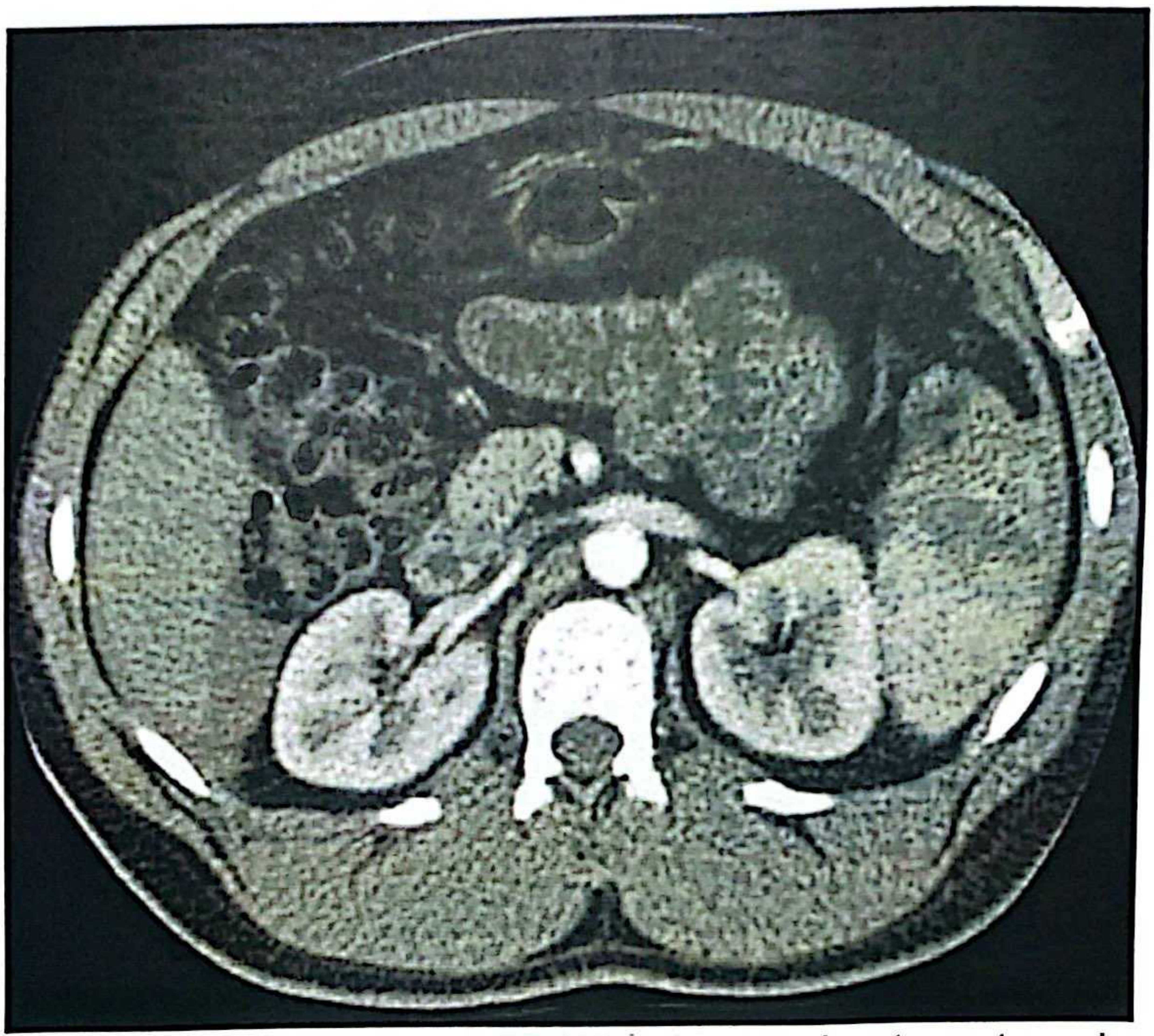
stage 1: homogeneously hypoechogenic cystic thin-walled lesion
stage 2: septated cystic lesion
stage 3: cystic lesion with daughter lesions
stage 4: pseudo-tumour lesion
stage 5: calcified or partially calcified lesion (inactive cyst)



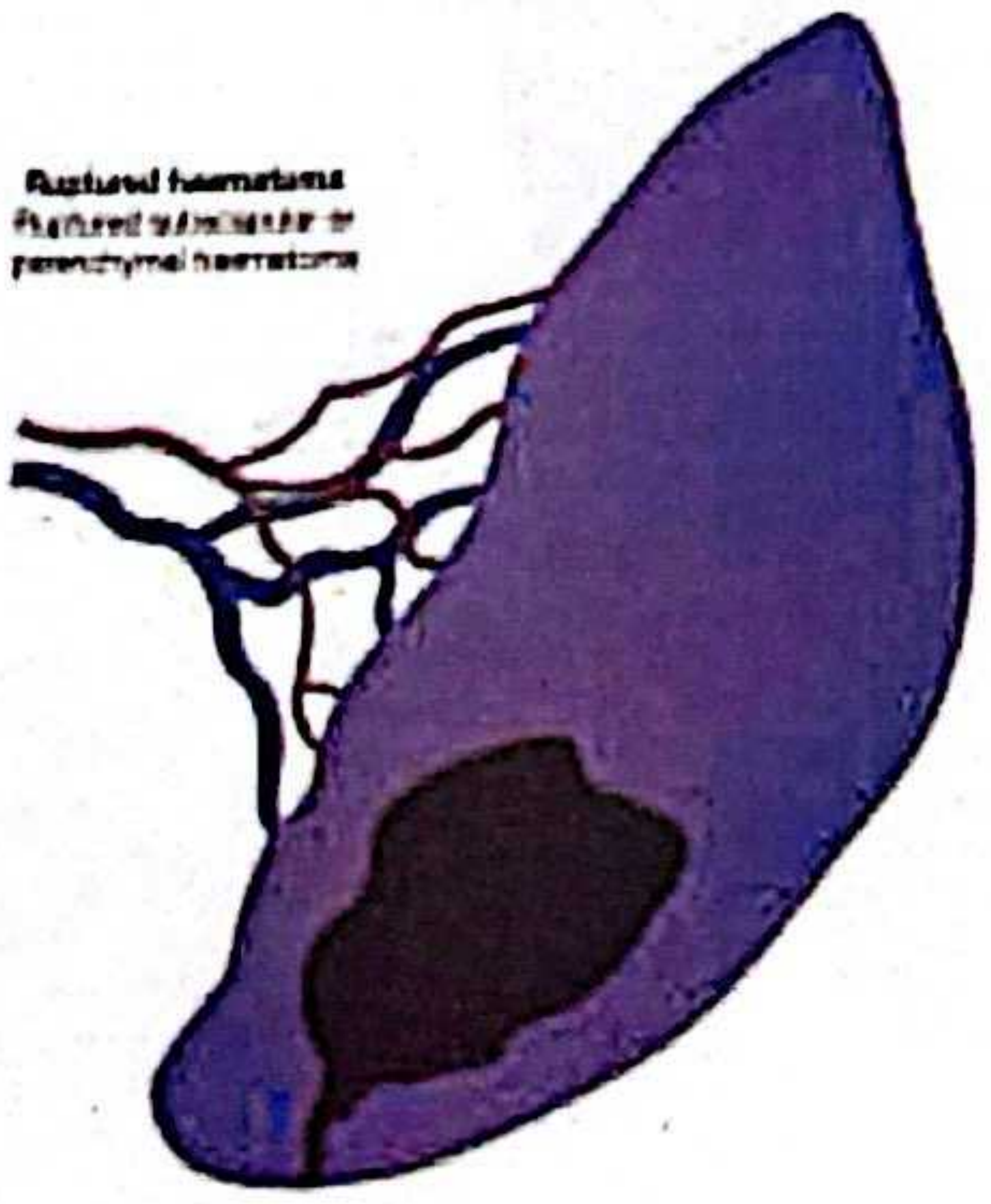
Summary of T1, and the various phases of the contrast study illustrating the nature of the focal liver lesion.

Note the enhancement of the central scar only on the delayed images when the rest of the lesion has washed out.
Focal nodular hyperplasia (FNH) is a benign 'tumour-like' mass of the liver. It has characteristic imaging features on contrasted-enhanced cross-sectional imaging.
FNH is most frequently identified in young to middle-aged adults, with a strong female predilection.
On CT and MRI the imaging features are classical, which are:
Intense early arterial phase enhancement, with the exception of the central fibrotic scar.
Isointense to liver on portal venous phase.
On the delay phase, the central scar enhances in most cases, as contrast is retained.

Q.12) **Knee hit the chest while playing Oztag. Left lower rib pain with severe dyspnoea and vomiting-25 years-Male (2014)**

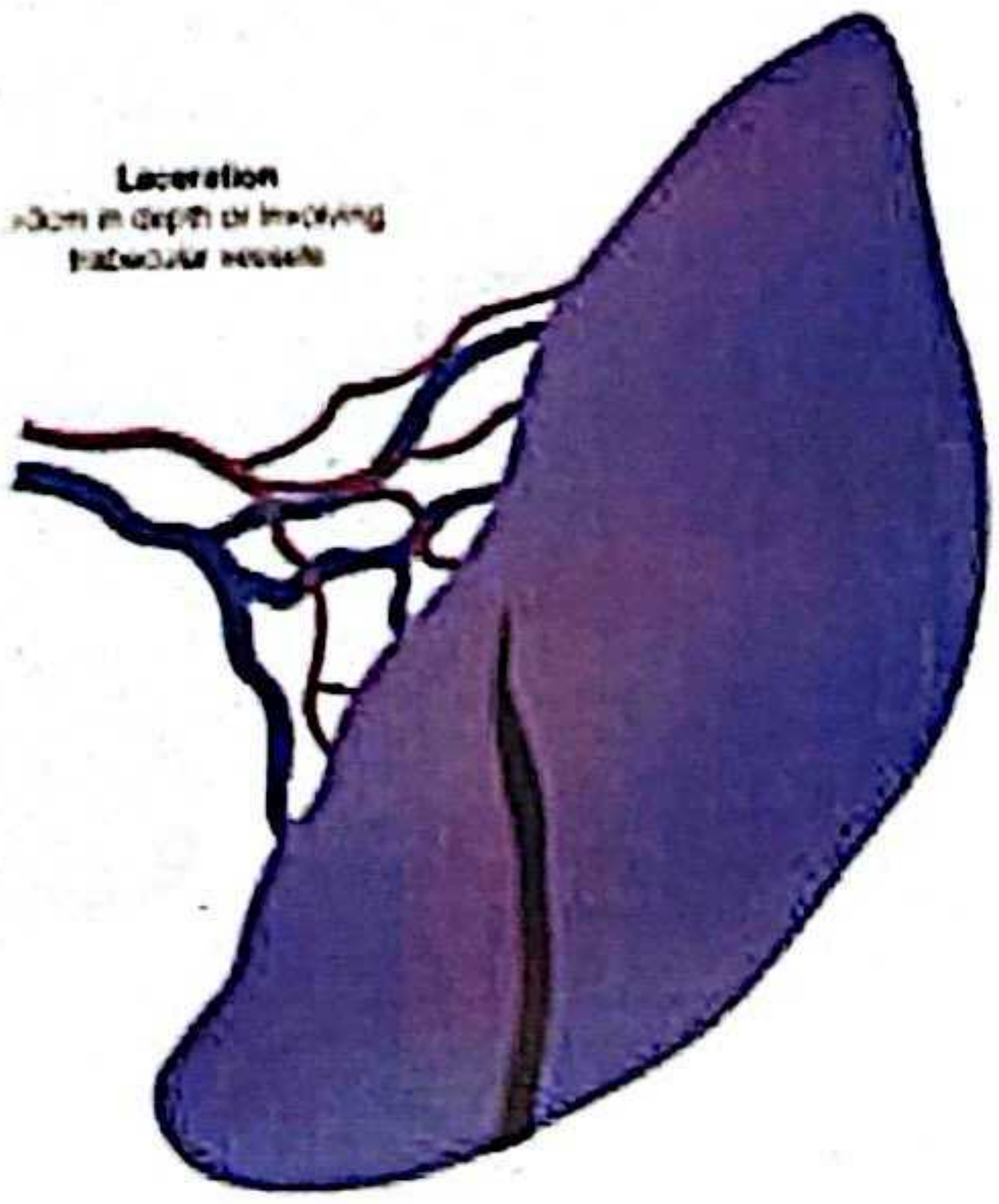


Splenic rupture with associated moderate to large haemoperitoneum. No splenic arterial pseudoaneurysm or active contrast extravasation identified. There is rupture of the splenic capsule with splenic laceration and parenchymal haematomas measuring up to 4.5 cm in diameter through the inferior pole, consistent with a grade 3 injury.



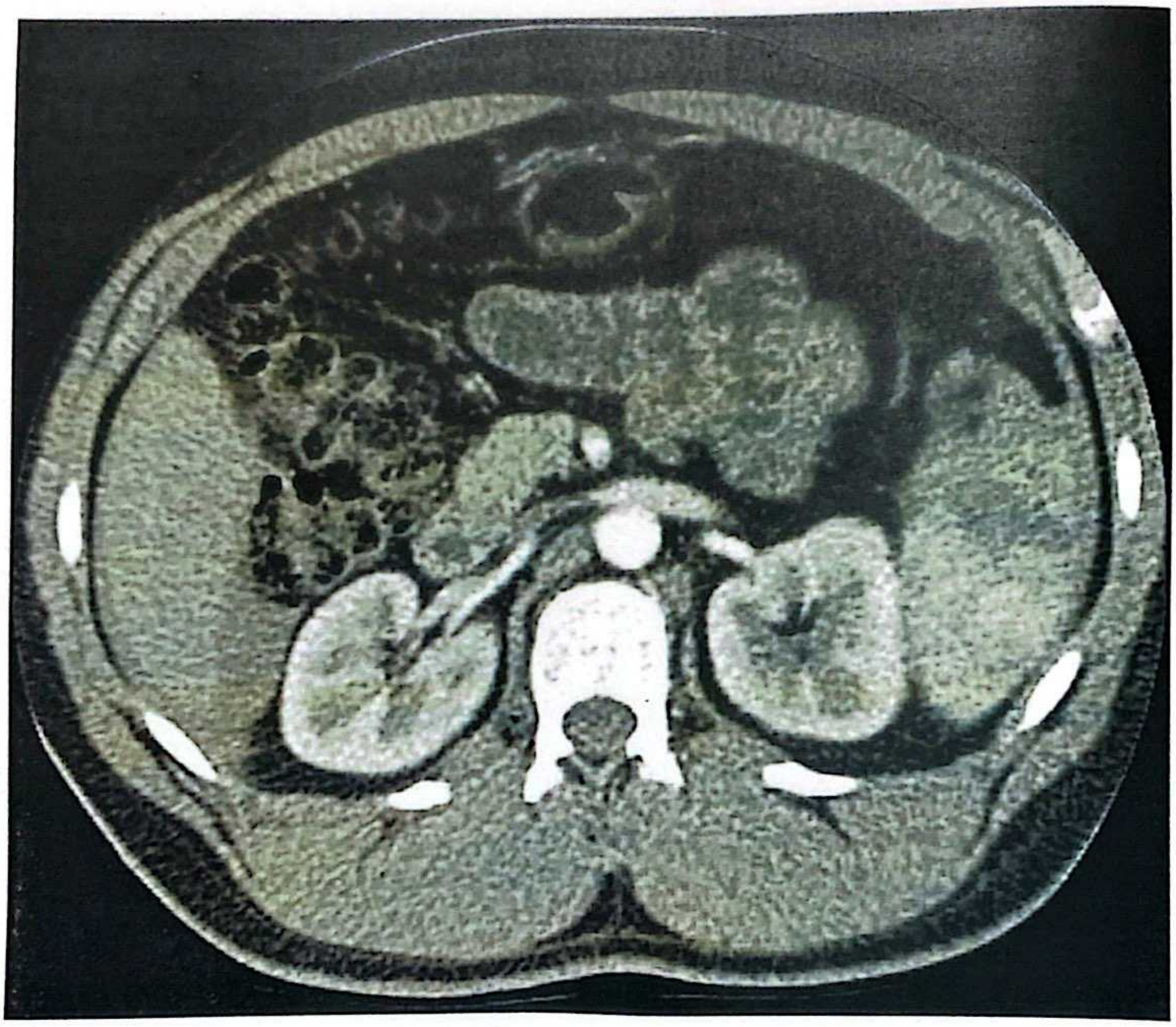
Grade III

Ruptured haematoma
Ruptured subcapsular or
parenchymal haematoma

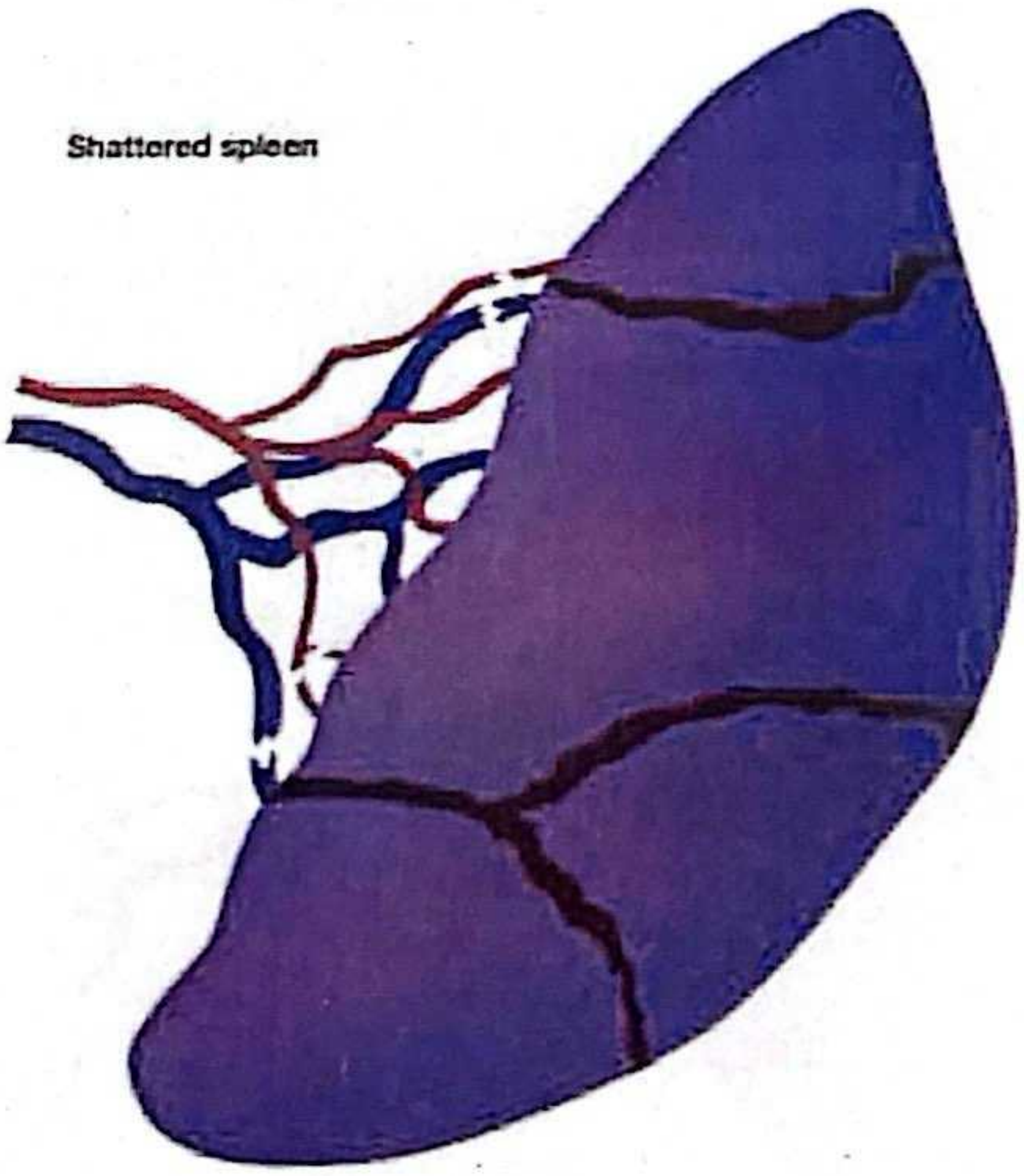


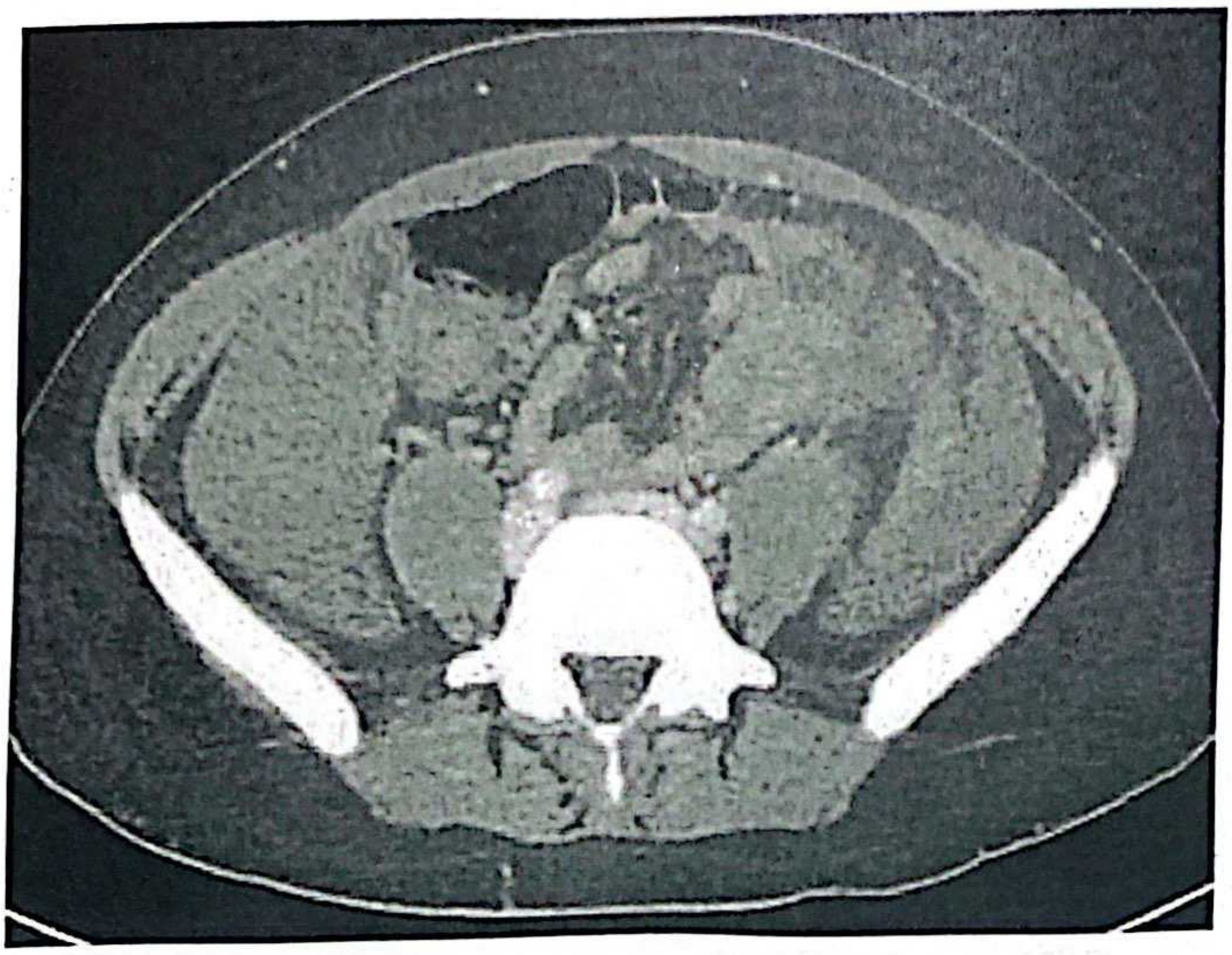
Grade III

Laceration
>3cm in depth or involving
trabecular vessels



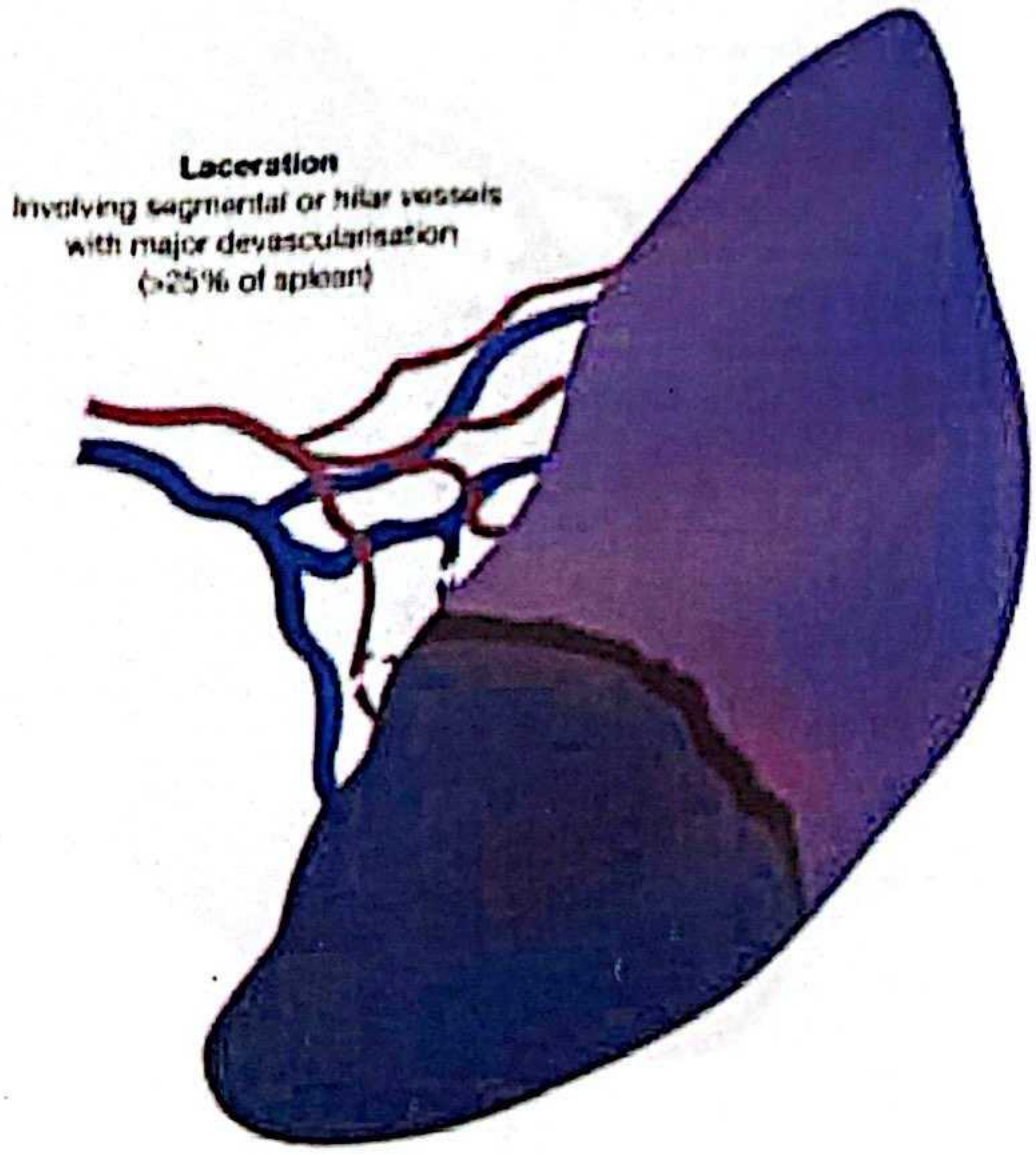
Grade V


Shattered spleen

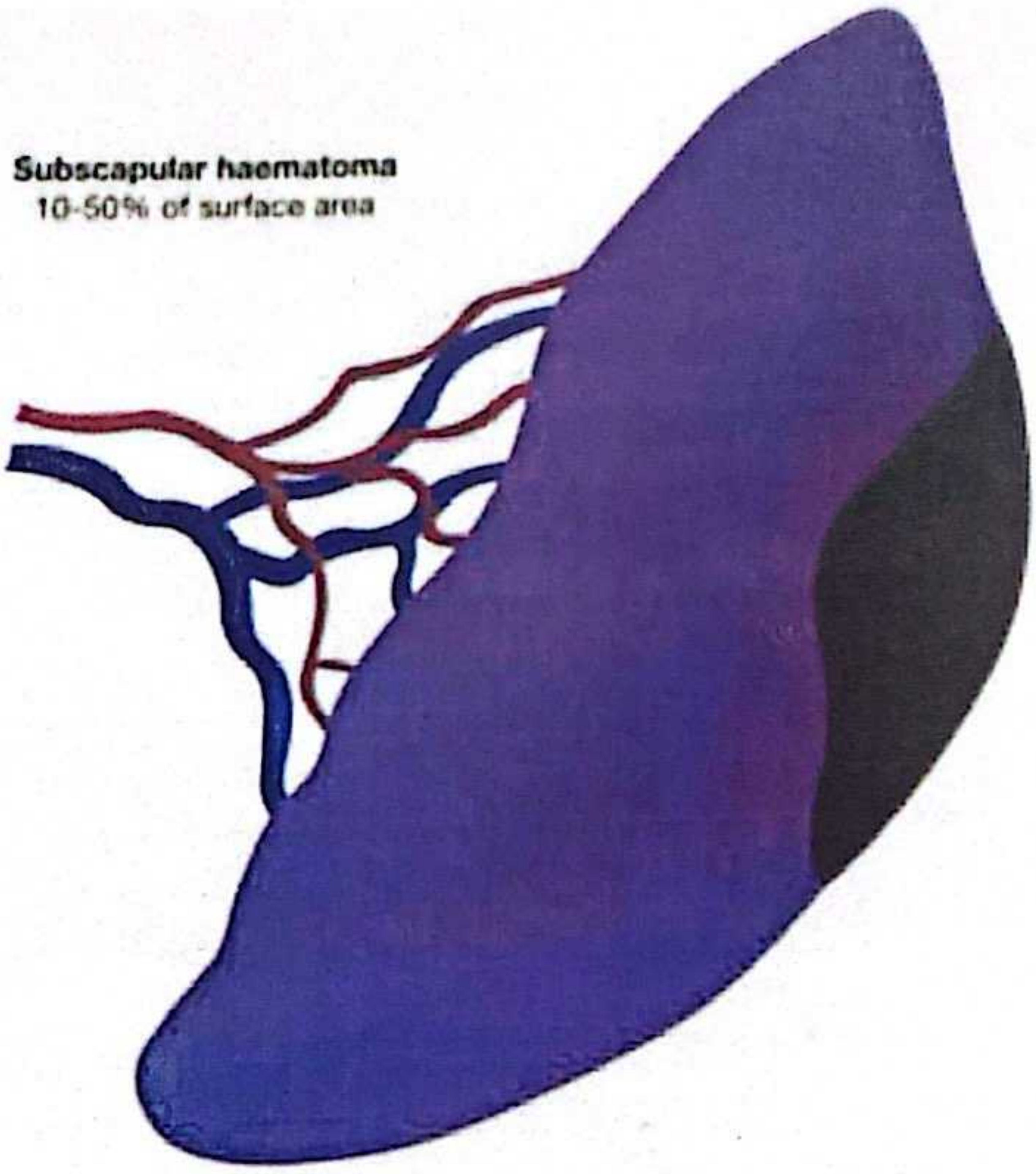


Extensive splenic lacerations extending to the hilum with areas of devascularisation. No evidence of active bleeding or pseudo-aneurysm. There is extensive haemoperitoneum throughout the abdominopelvic cavity. Cholecystectomy clips are noted along with extrahepatic and first order intrahepatic duct dilatation. Liver is uninjured. Adrenal glands, kidneys and pancreas are uninjured. Bowel is unremarkable. Lung bases are clear. No bony injury identified

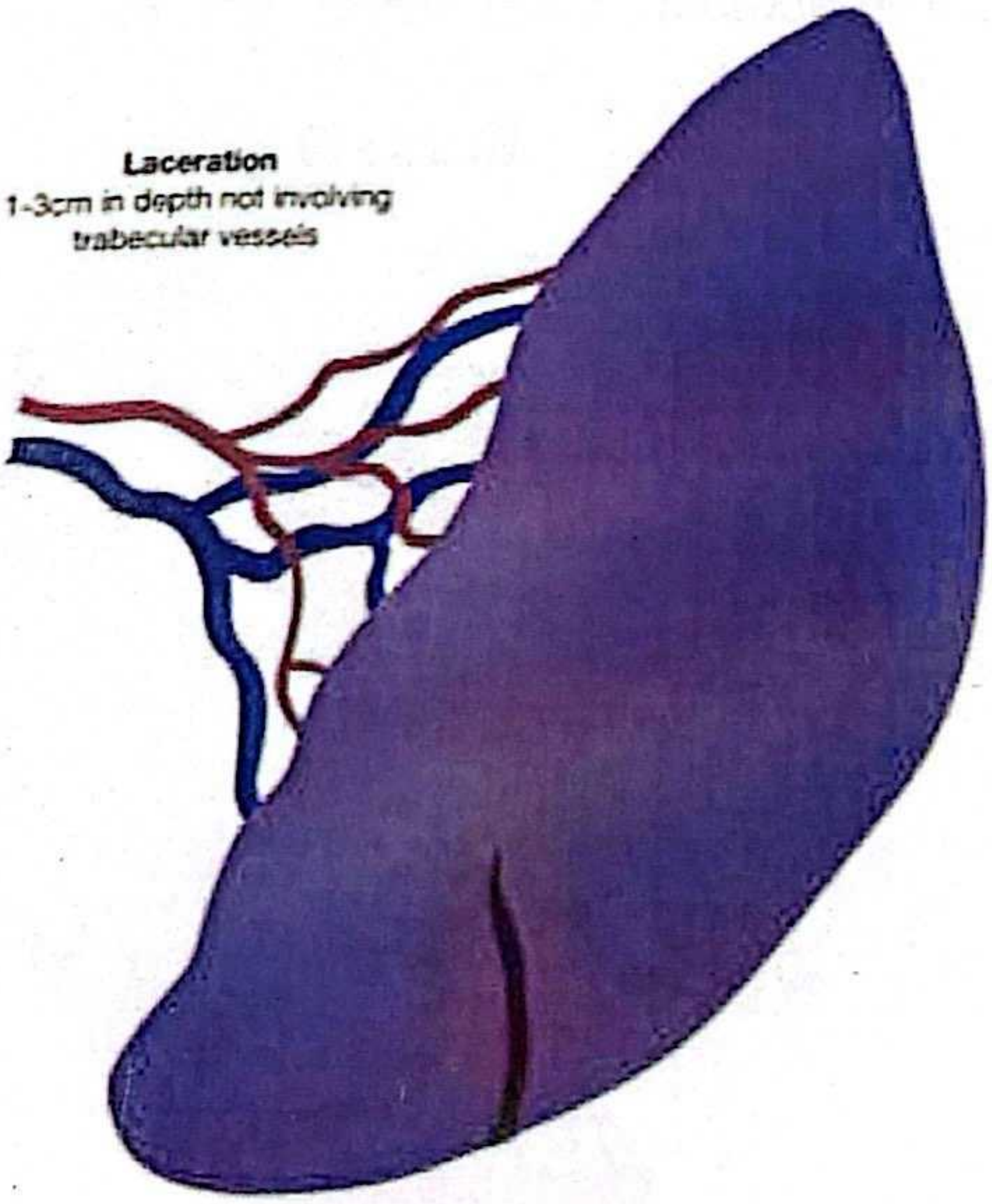
Grade IV


Laceration
Involving segmental or hilar vessels
with major devascularisation
(>25% of spleen)

Grade II

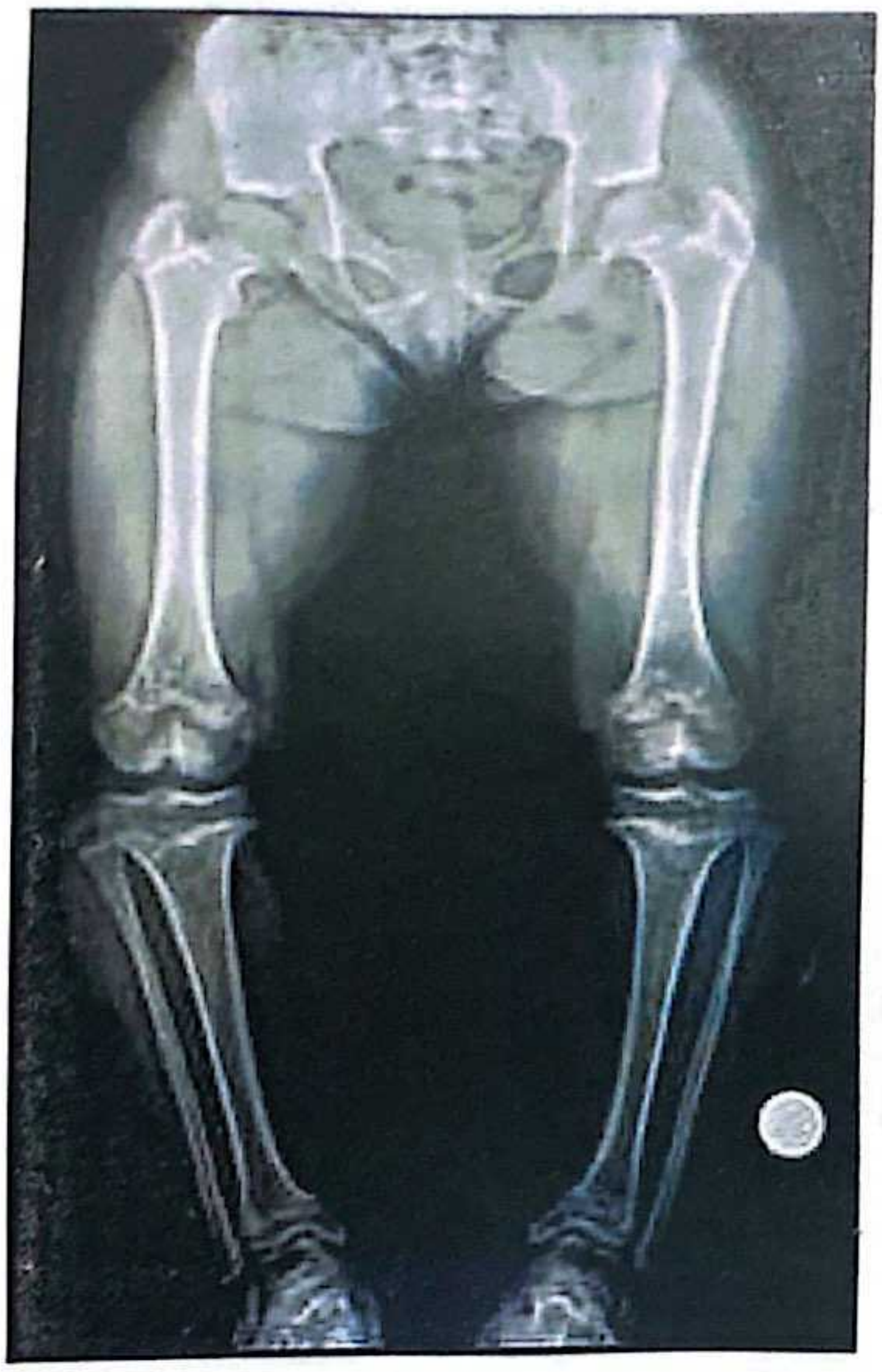

Subscapular haematoma
10-50% of surface area

Grade II


Laceration
1-3cm in depth not involving
trabecular vessels

MUSCULOSKELETAL SYSTEM

Q.1) **(2017), (2015)**



Identify: Plain X-ray Lower Limb Frontal Projection

Describe: Rhizomelic dwarfism, with relatively short femora

Bilateral genu vara.

Metaphyseal flaring, most evident at the lower femora, giving trumpet bone type appearance

Relatively long fibulae.

V shaped growth plates, most evident at the upper tibiae

Diagnosis: Achondroplasia

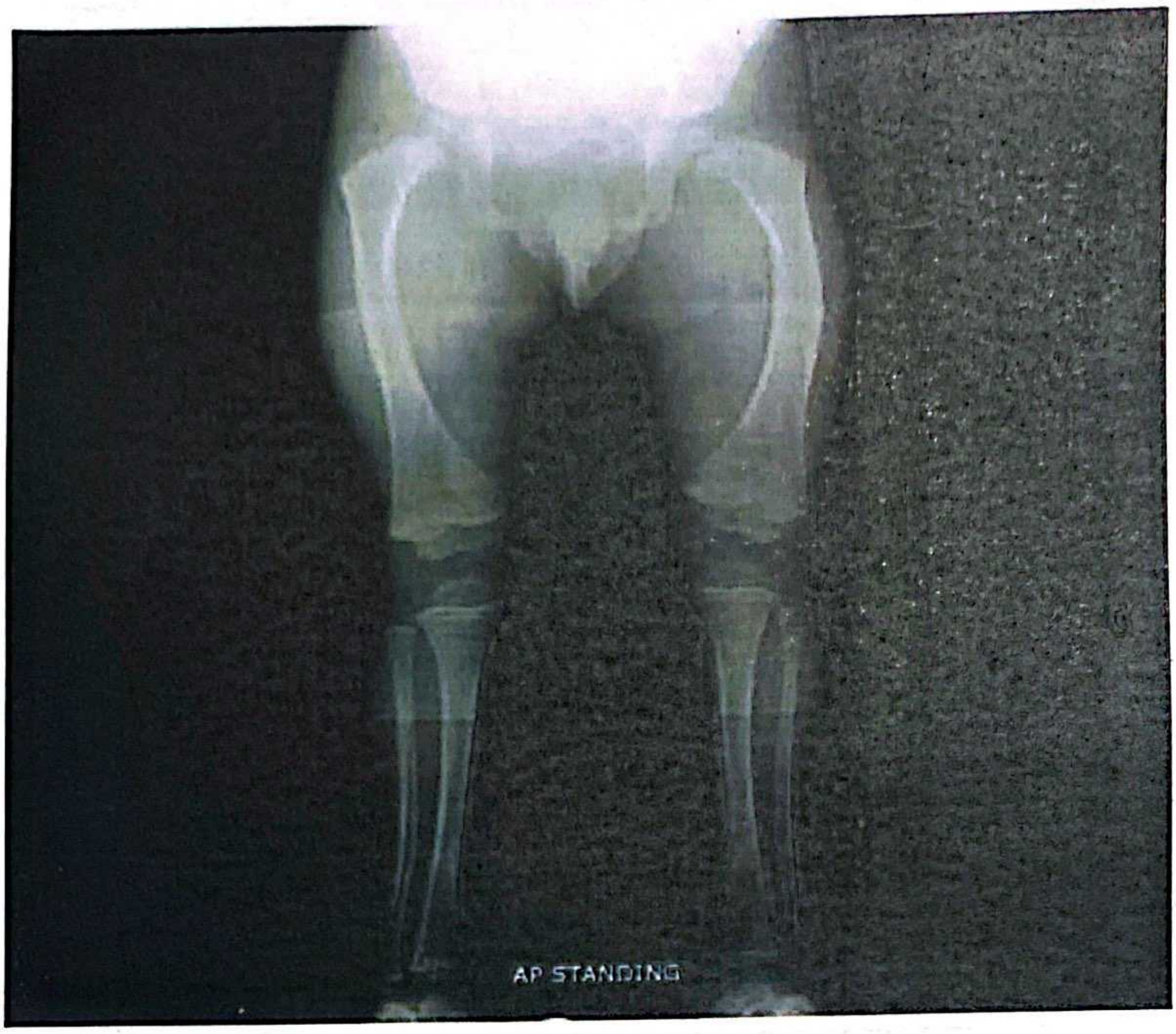
What next:

- There is often a danger of cervical cord compression due to narrowing of the foramen magnum.
- Decompress the foramen magnum or shunt hydrocephalus

Differential diagnosis

- Achondrogenesis
- Campomelic dysplasia
- Thanatophoric dysplasia
- Chondroectodermal dysplasia (Ellis-van Creveld syndrome)

Q.2)



Identify: Plain X-ray Lower Limb Frontal Projection
Describe: There is bowing of both femora which is symmetric. Multiple growth arrest lines in the femora and tibia.
Diagnosis: Osteogenesis imperfecta
What next: Surgical correction of deformities and the prevention of fractures, Chest X Ray
To see pectus excavatum or carinatum

CT

- While showing most of the plain film features, CT may also better demonstrate:
- wormian bones
- basilar invagination
- otosclerosis

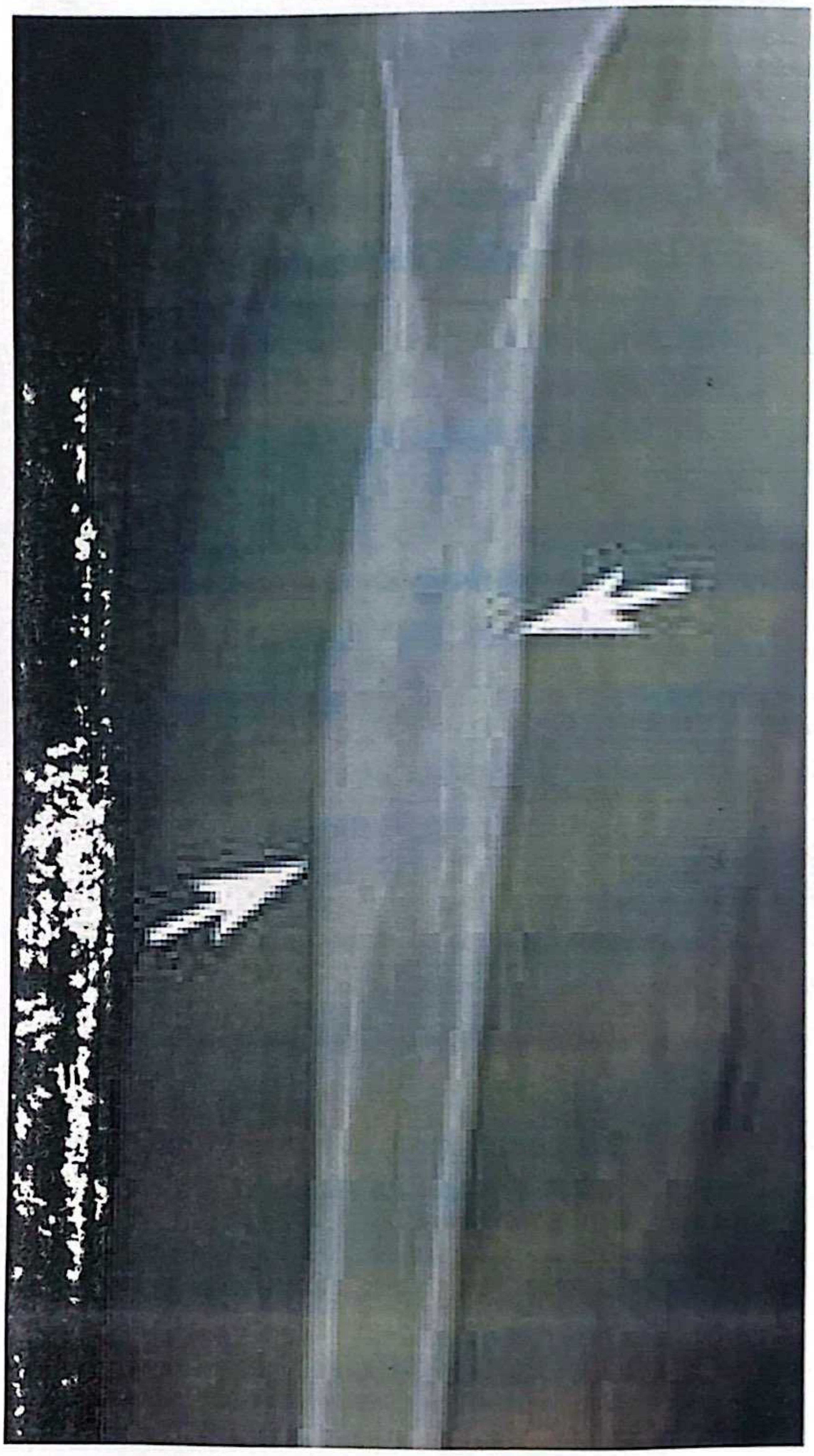
MRI

can be used to assess extent of basilar invagination

Differential diagnosis:

- juvenile osteoporosis
- Menkes syndrome (or kinky-hair syndrome)
- hypophosphatasia
- battered child syndrome (syndrome X)
- temporary brittle-bone disease
- child abuse

Q.3) **(2017)**



Identify: Plain Radiograph left thigh in AP projection

Describe: Radiograph show increased cortical thickness involving the mid femoral shaft on the medial aspect with associated sclerosis and a narrow zone of transition. There is also a focal round lucent / lytic focus within the center of the sclerotic lesion suggestive of a nidus.

✓ **Diagnosis:** osteoid osteoma

What next:

CT

- Excellent at characterizing the lesion and is the modality of choice.

Nuclear medicine

- Scintigraphy will show typical focal uptake and at times will show a double density sign. The central focus showing intense uptake within a surrounding lower

Ultrasound

- On ultrasound, focal cortical irregularity with adjacent hypoechoic synovitis may be present at the site of intra-articular lesions. The nidus can show hypoechogenicity with posterior acoustic enhancement. Ultrasound may be able to identify the nidus as a hypervascular nidus on Doppler examination.

MRI

- Although MRI is sensitive, it is non-specific and is often unable to identify the nidus. The hyperaemia and resultant bone marrow edema pattern may result in the scans being misinterpreted as representing aggressive pathology

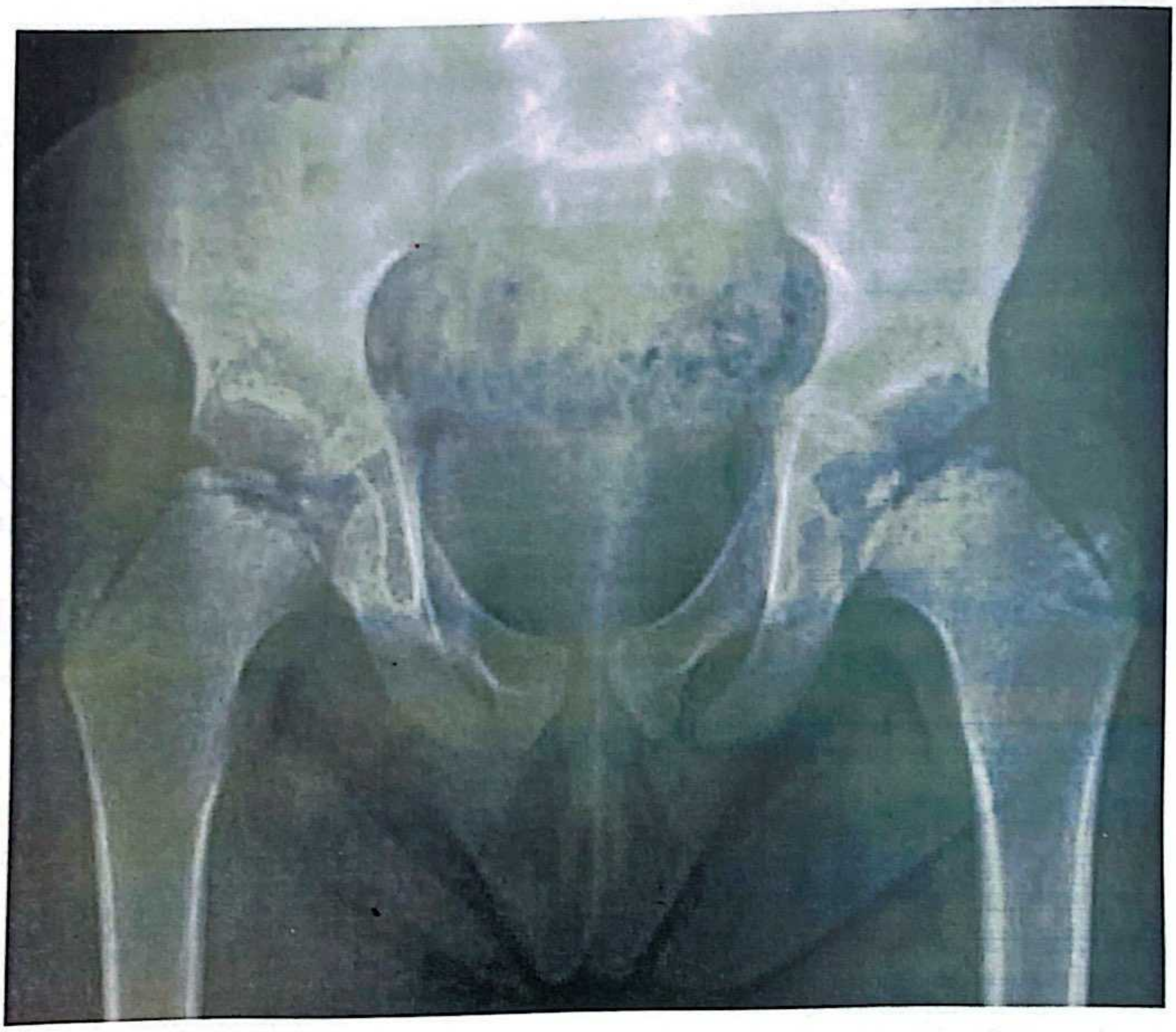
Treatment

- The lesion is benign, and treatment has traditionally been with surgical resection.
- Percutaneous radiofrequency ablation under CT guidance.
- Can be treated conservatively with NSAIDs.

Differential diagnosis

- osteomyelitis (e.g. Brodie abscess): bone scan demonstrates central area of reduced uptake representing an avascular area of purulent material
- osteoblastoma: >2 cm in size
- stress fracture
- cortical desmoid
- osteochondroma
- osteosarcoma
- enostosis (bone island)

Q.4) (2016)



Identify: Plain X-Ray Pelvis with both hip joints Frontal Projection

Describe:

- Both femoral head shows fragments (stage 2), with subchondral lucency (crescent sign)
- Both femoral epiphyses show destruction, the acetabula are deformed with widening and flattening (coxa plana) with proximal femoral neck deformity: coxa magna
- Showing "sagging rope sign" (thin sclerotic line running across the femoral neck)
- Tongues of cartilage extending inferolaterally into the femoral neck
- There is thickening of some trabeculae

Diagnosis: Legg-Calve-Perthes disease

What next:

Arthrography
Conventional fluoroscopy

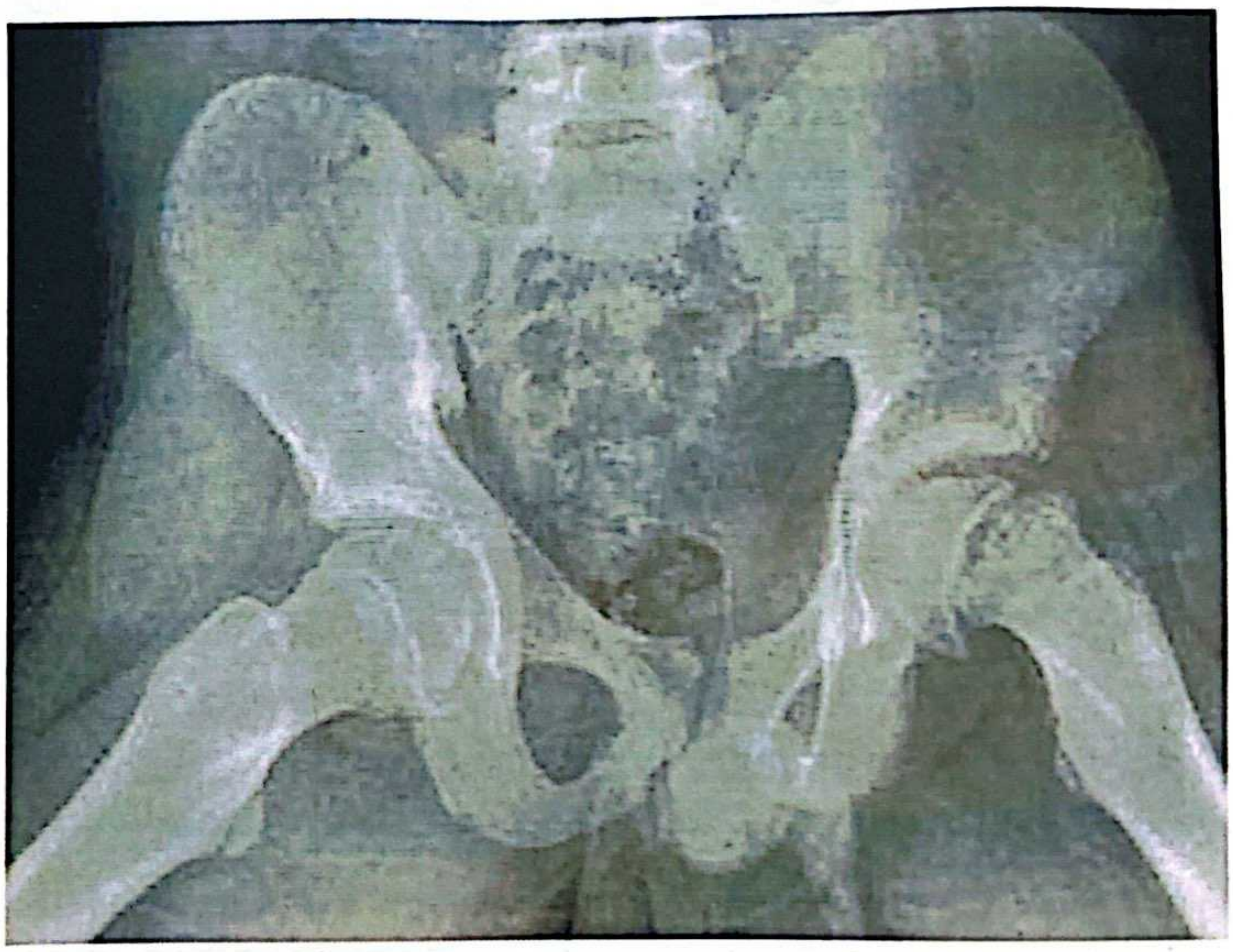
MRI

- Eliminate pelvic irradiation
- early diagnosis, before the onset of x-ray findings
- assessing the extent of cartilaginous involvement, important in prognosis
- assessing joint congruence in a variety of joint positions

Treatment

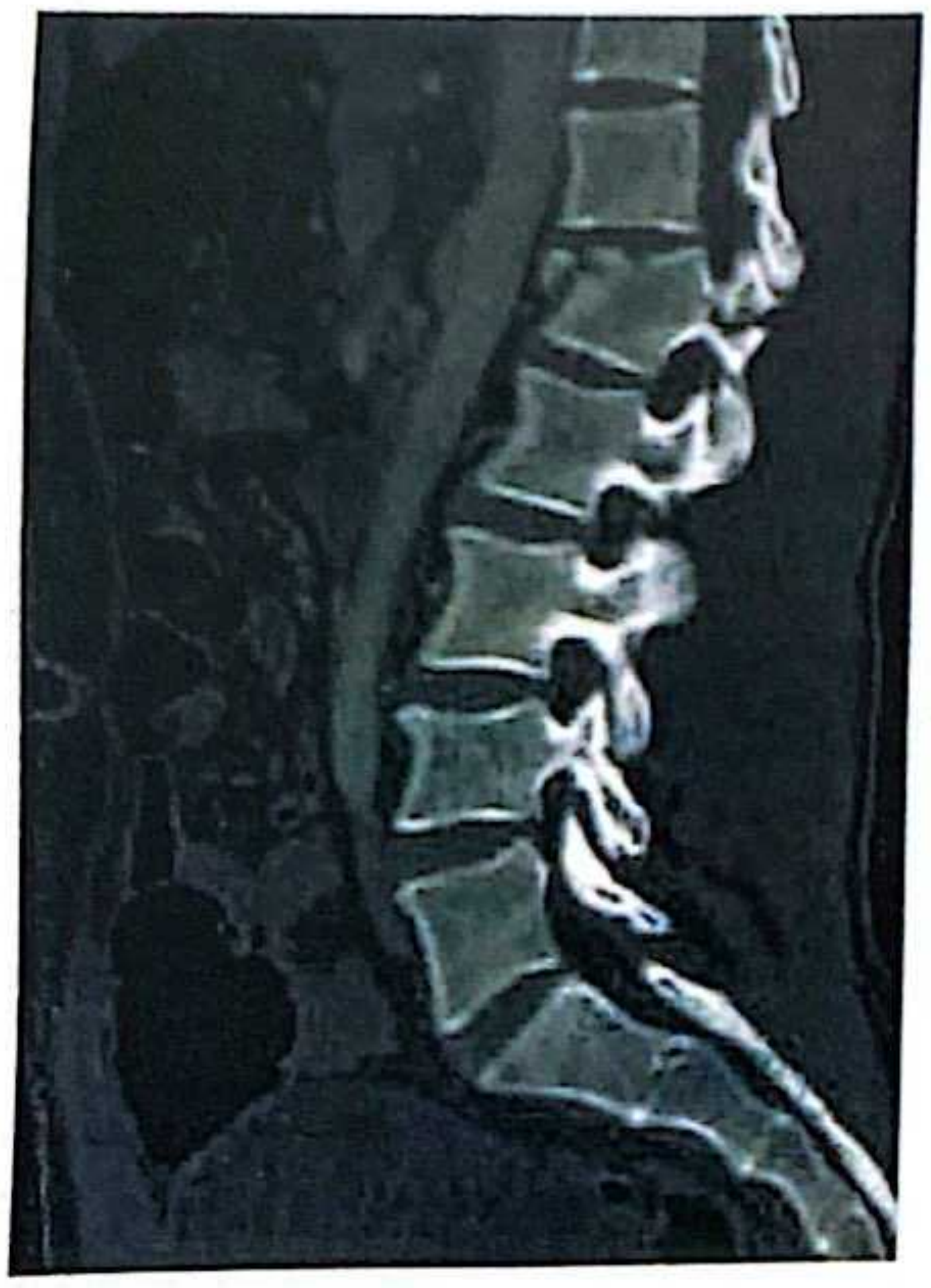
- Symptomatic control, particularly in the early phase of the disease.
- As the disease progresses, replace the femoral head in adult life.

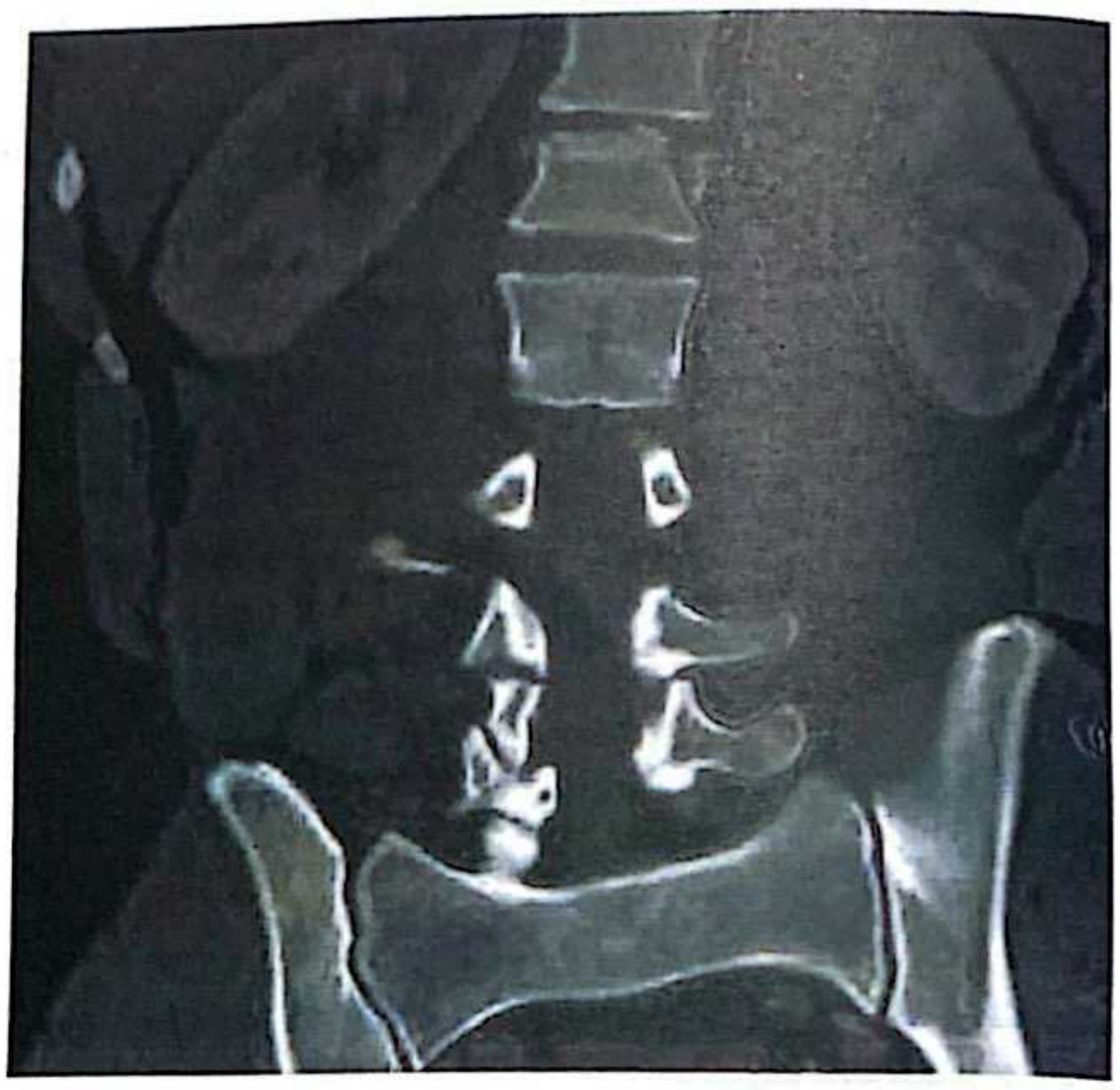
Differential Diagnosis:

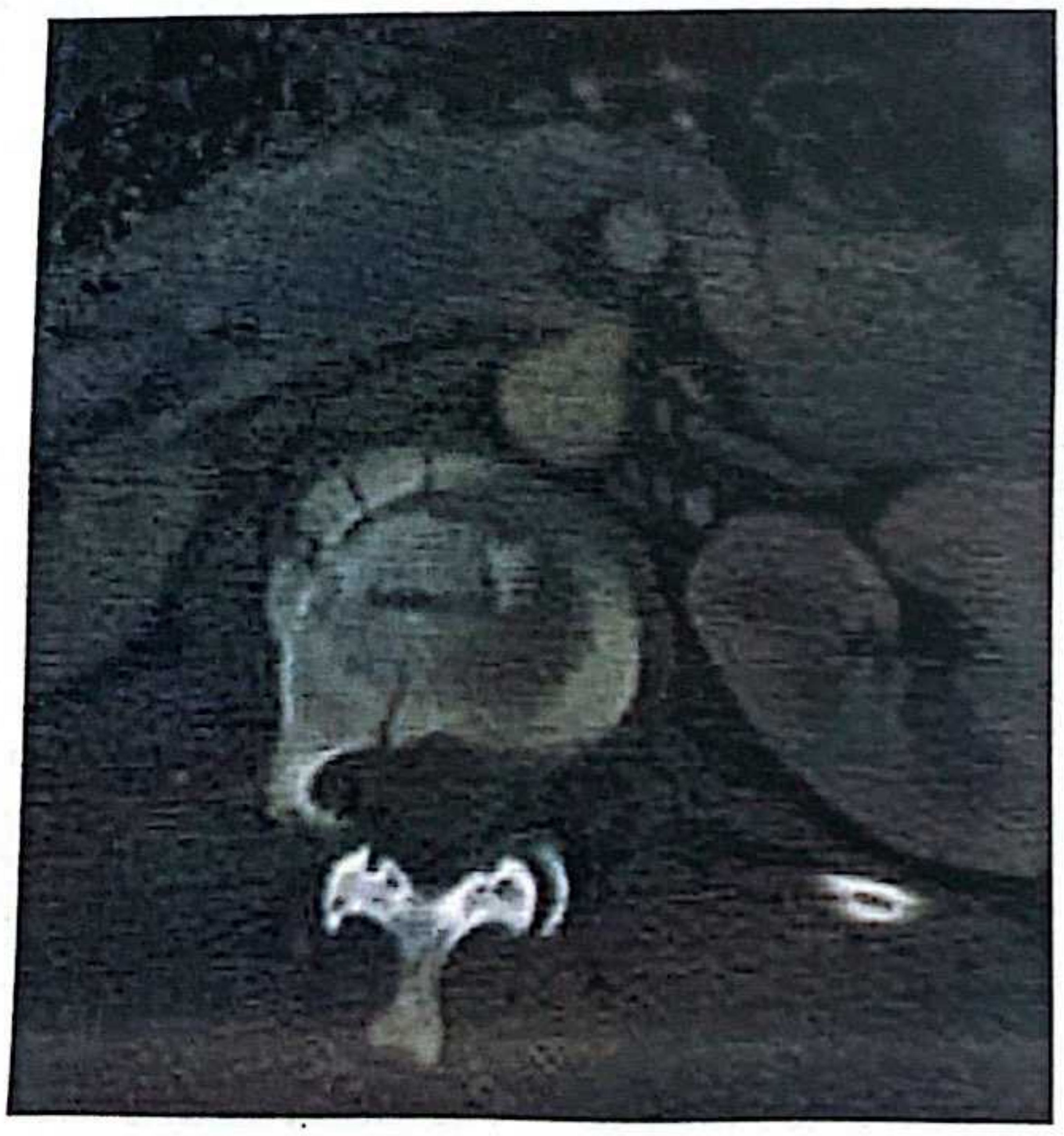


- Slipped superior femoral epiphysis (SUFE)
- Osteomyelitis
- Secondary causes of osteonecrosis
- Dysplasia epiphysealis capitis femoris (Meyer dysplasia)
- Tumours
- Haemophilia
- Juvenile rheumatoid arthritis (JRA)

Q.5) **(2017)**







Identify: Unenhanced CT Lumbo Sacral Spine with Saggital Coronal and Axial Slices with bone window

Describe: Fracture involving the L1 vertebral body with involvement of posterior elements (transverse fracture) and mild anterior wedging (compression fracture) of the L1 vertebral body

Diagnosis: Chance Type fracture

What next:

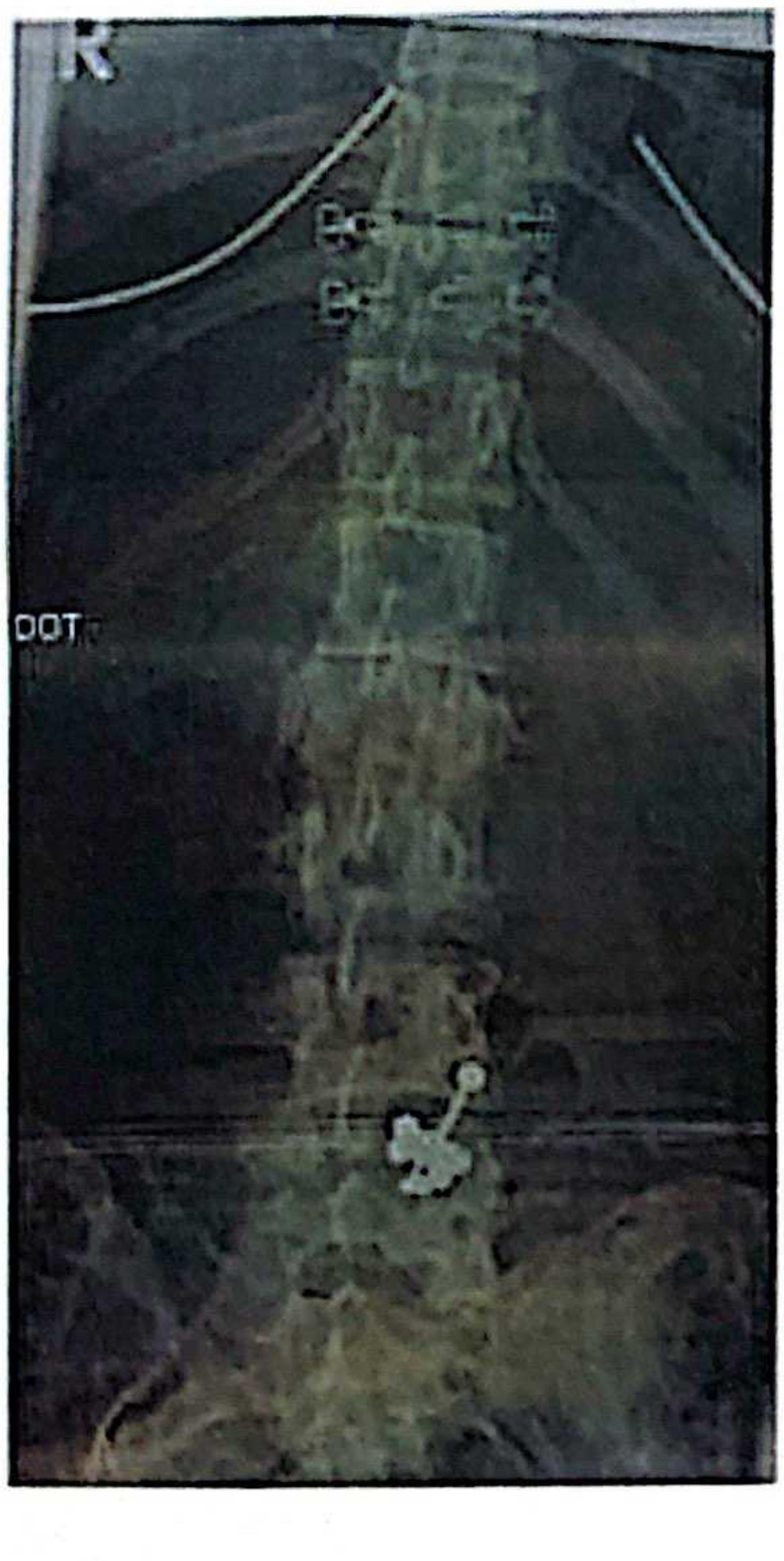
Fast Scan

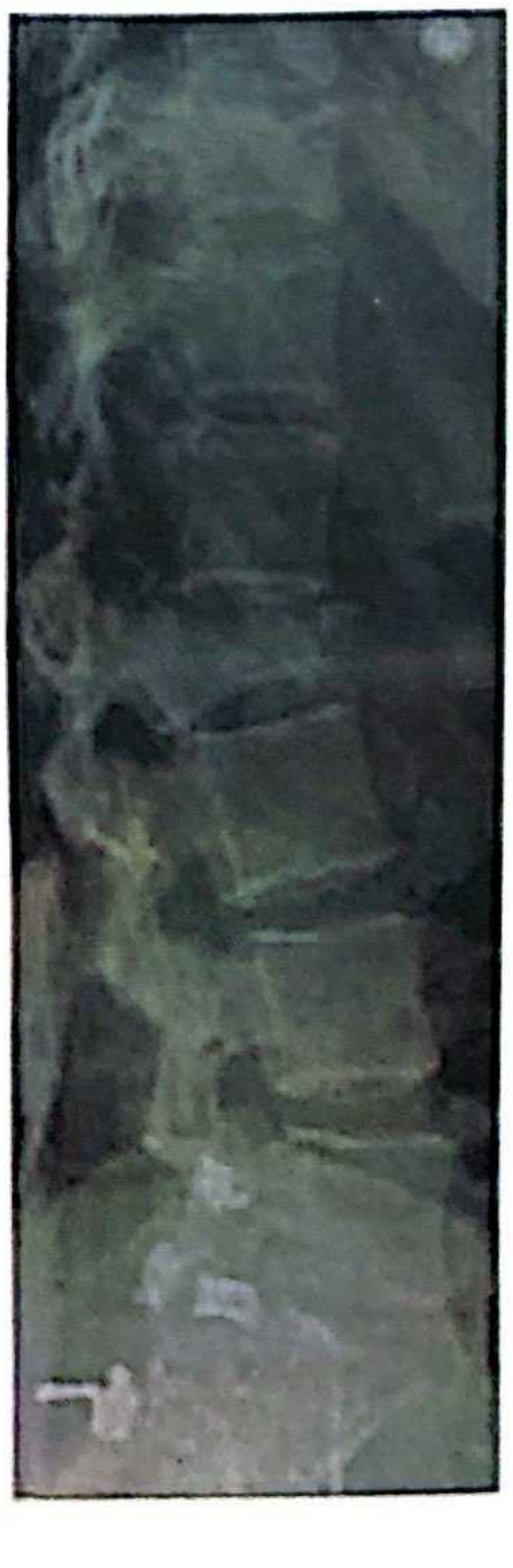
- As there is a high incidence of associated intra-abdominal injuries (especially the pancreas and duodenum)

Complication: Chance injuries may result in progressive kyphosis with resulting pain and deformity.

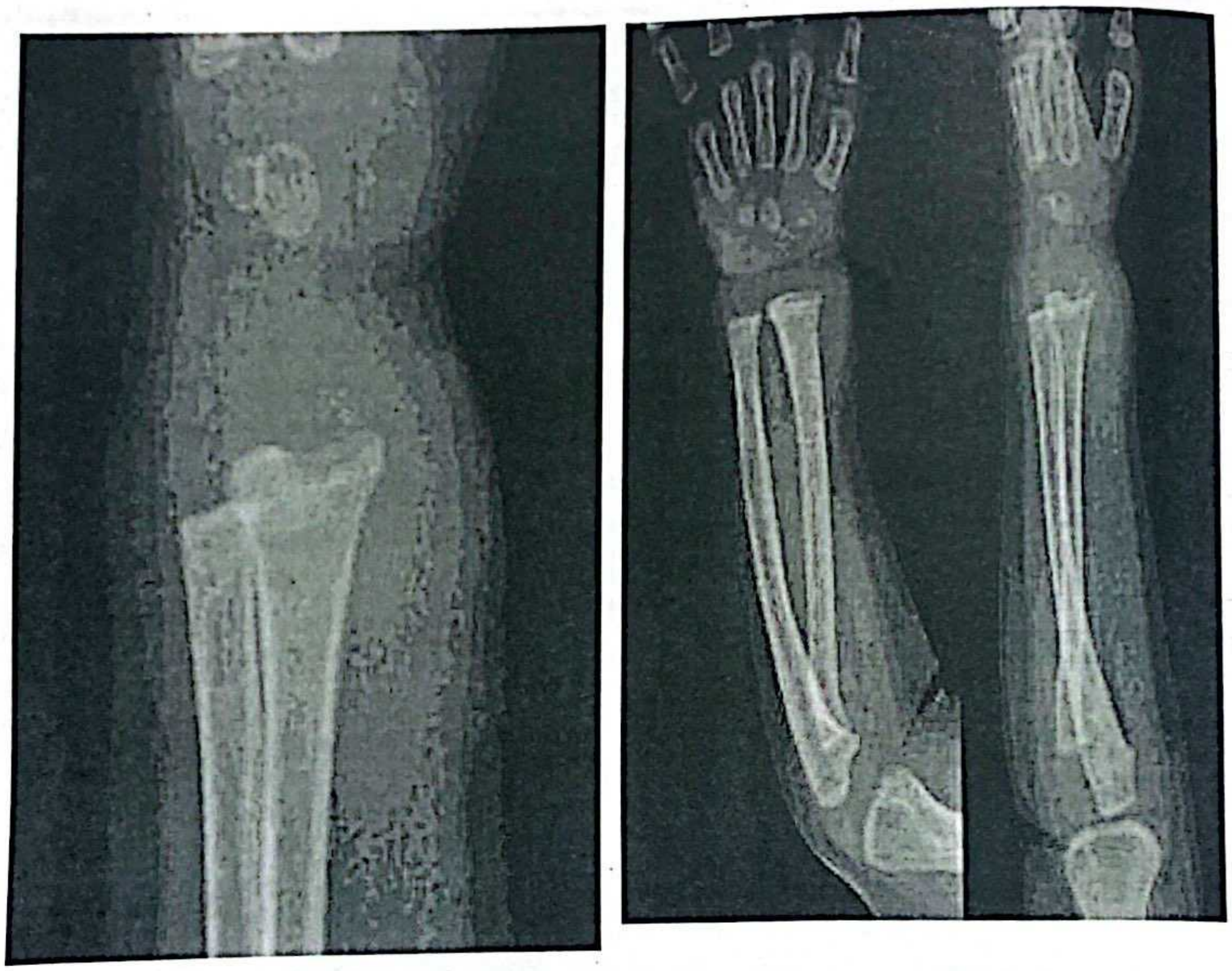
Plain radiograph

- empty vertebral body sign: can be seen on an AP radiograph and results from the vertical separation of the posterior elements displacing the spinous processes or spinous process fracture fragments off the vertebral body on the AP projection
- transverse fractures across the transverse processes, laminae, and articular processes
- widening of the interpedicular distance: often suggests a burst component
- widening of the facet joints and increased intercostal spacing
- widening of the interspinous spaces





Q.6) **8-month-old boy with 10-day history of left wrist swelling (2017)**



Identify: Plain radiographs AP and Lateral views wrist joint

Describe:

- There is lucency of the distal radial metaphysis and marked surrounding soft tissue swelling with regional osteopenia.
- Loss or blurring of normal fat planes
- Mild focal bony lysis or cortical loss is seen

Diagnosis: Osteomyelitis

What next:

- Bone scintigraphy (Tc99m)
- In111 labelled WBC
- Gallium67 scintigraphy
- FDG-PET may have the highest diagnostic accuracy for confirming or excluding chronic osteomyelitis

CT

The CT features are otherwise similar to plain films. The overall sensitivity and specificity of

MRI

MRI is most se
tissue/joint comp

Ultrasound

Examination of t
be drained it has
as it is unable to

Treatment

Treatment is t
extended period

Complications

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Differential dia

- Charcot
- metasta
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MRI

MRI is most sensitive and specific and is able to identify soft-tissue/joint complications

Ultrasound

Examination of the soft tissues, and allows soft tissue collections to be drained it has little direct role in the assessment of osteomyelitis, as it is unable to visualize within bone.

Treatment

Treatment is typically with intravenous antibiotics, usually for extended periods.

Complications include:

- sinus track formation with occasional superimposed squamous cell carcinoma (Marjolin ulcer)
- secondary sarcoma (e.g. osteosarcoma): rare
- pathological fracture
- secondary amyloidosis

Differential diagnosis:

- Charcot joint
- metastases
- primary bone neoplasm
- Ewing sarcoma
- osteosarcoma
- lymphoma
- multiple myeloma
- Langerhans cell histiocytosis (LCH)

Plain radiograph Features:

- regional osteopaenia
- periosteal reaction/thickening (periostitis):appear aggressive including formation of a Codman's triangle
- focal bony lysis or cortical loss
- endosteal scalloping
- loss of bony trabecular architecture
- eventual peripheral sclerosis
- In chronic or untreated cases eventual formation of a sequestrum, involucrum or cloaca may be seen.

MRI

MRI is most sensitive and specific and is able to identify soft-tissue/joint complications

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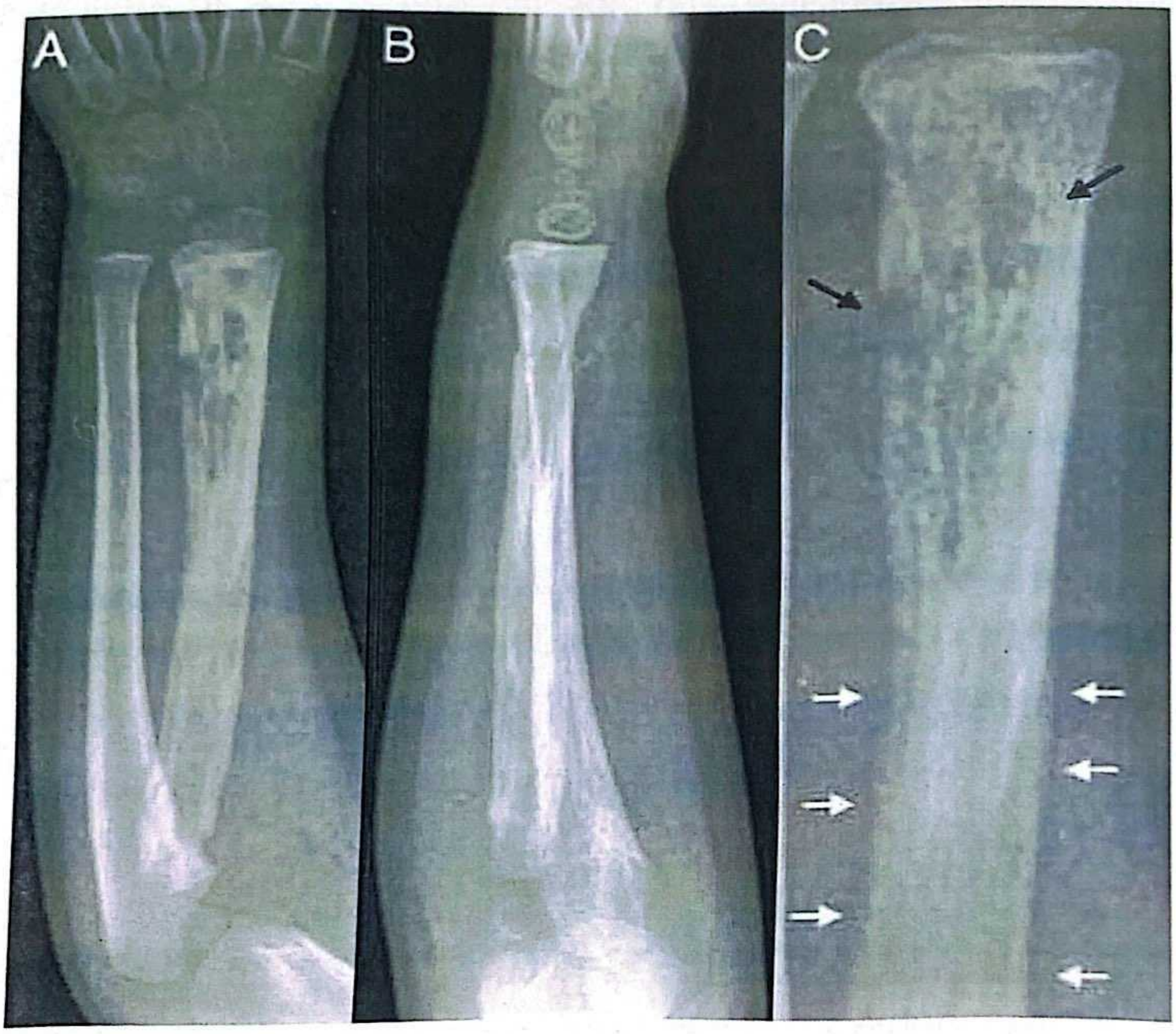
Q.7) **(2018)**



Identify: PA and Lateral radiographs of the right forearm showing radius ulna and wrist joint

Describe:

1. Diffuse, permeative mixed lytic and sclerotic process involving the entire radius.
2. Marked laminated periosteal thickening along the radius
3. Regional osteopaenia
4. Formation of a codman's triangle
5. Focal bony lysis or cortical loss
6. Endosteal scalloping
7. Loss of bony trabecular architecture
8. New bone apposition
9. Eventual peripheral sclerosis
10. Formation of a sequestrum, involucrum or cloaca

Diagnosis: Osteomyelitis

What next:

MRI

- MRI is most sensitive and specific and is able to identify soft-tissue/joint complications

T1

- Intermediate to low signal central component (fluid)
- Surrounding bone marrow of lower signal than normal due to oedema
- Cortical bone destruction

T2

- Bone marrow oedema
- Central high signal (fluid)

T1 C+

- Post contrast enhancement of bone marrow, abscess margins, periosteum and adjacent soft tissue collections

Bone scintigraphy (Tc99m)

- Increased osteoblastic activity results in increased levels of radiotracer uptake in the surrounding bone usually both on blood pool and delayed views.

In111 labelled WBC and Gallium67 scintigraphy

Gallium67 scintigraphy

- Gallium scans may reveal abnormal accumulation in patients who have active osteomyelitis when technetium scans reveal decreased activity (“cold” lesions) or perhaps normal activity.

FDG-PET may have the highest diagnostic accuracy for confirming or excluding chronic osteomyelitis in comparison with bone scintigraphy

Treatment

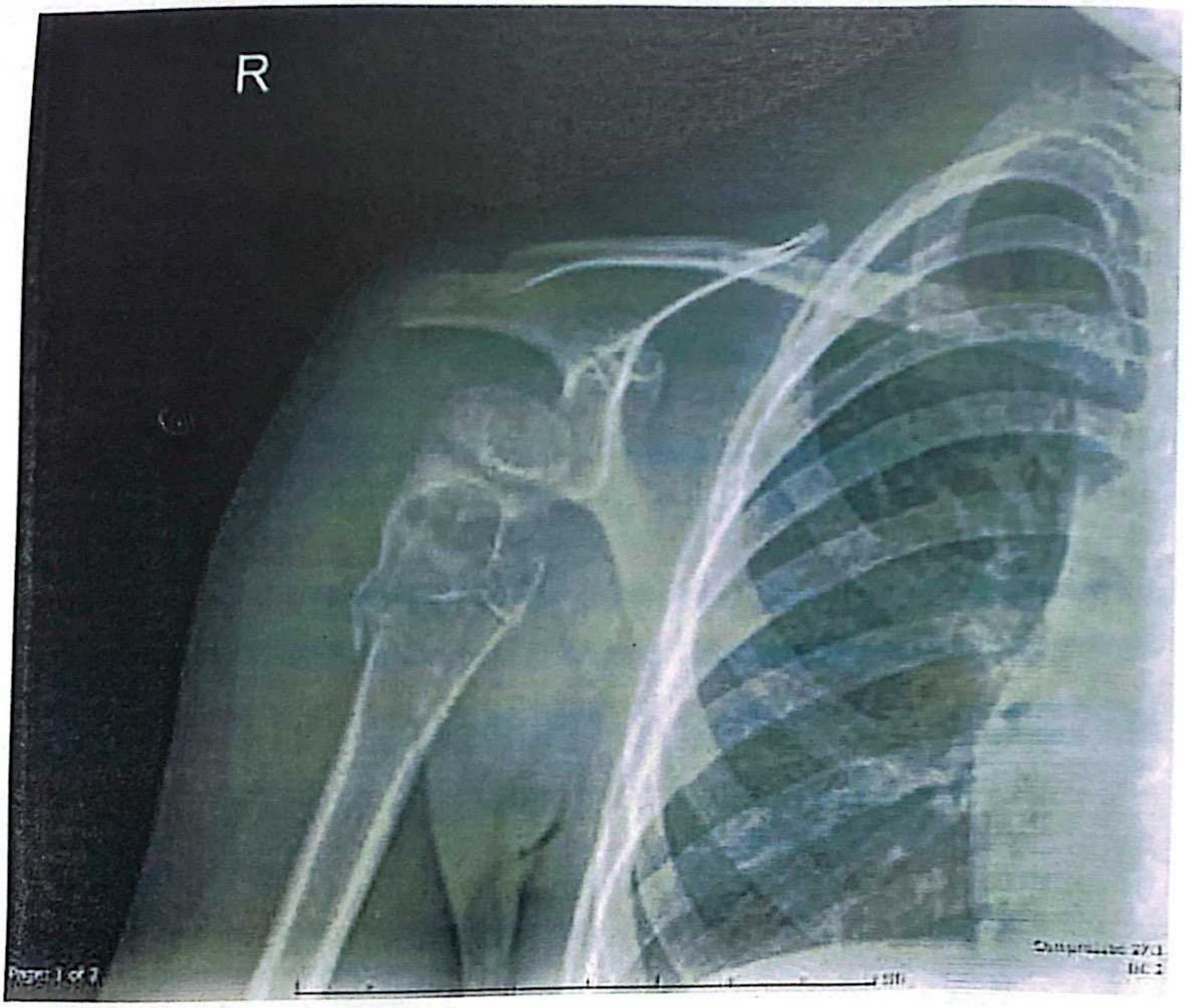
- Treatment is typically with intravenous antibiotics, usually for extended periods

Differential diagnosis:

1. Charcot joint
2. Metastases
3. Primary bone neoplasm
4. Ewing sarcoma
5. Osteosarcoma
6. Lymphoma
7. Multiple myeloma
8. Langerhans cell histiocytosis (LCH)

Q.8) **(2017)**

Identify: Plain Radiograph Shoulder AP projection



Describe:

- There is a solitary, unilocular, well-defined lucent lesion centrally located within the proximal humeral metaphysis which extends into the proximal diaphysis, occupying the entire diameter of the bone.
- The lesion is mildly expansile with mild cortical thinning.
- No periosteal reaction is evident.
- There are multiple lucent fracture lines extending through the lesion, with two small comminuted cortical fragments within the lesion, representing the "fallen fragment sign."
- There is minimal offset and no angulation of the distal humerus.

Diagnosis: Unicameral bone cyst

What next:

Scintigraphy

- Tends to be photopenic (cold spot)

CT and MRI

Helpful in eliminating other entities that can potentially mimic a simple bone cyst

MR signal characteristics for an uncomplicated lesion include:

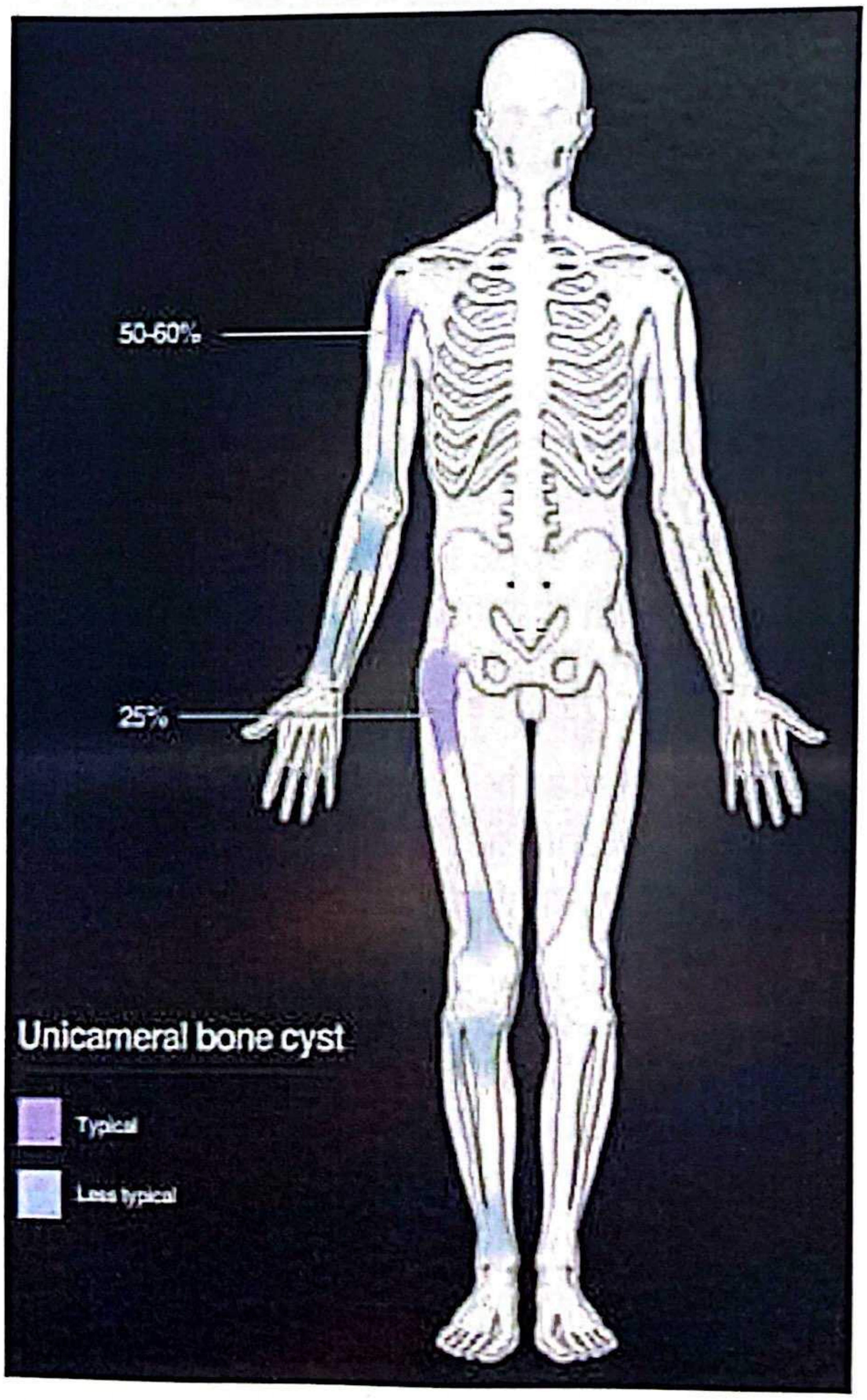
T1: low signal

T2: high signal

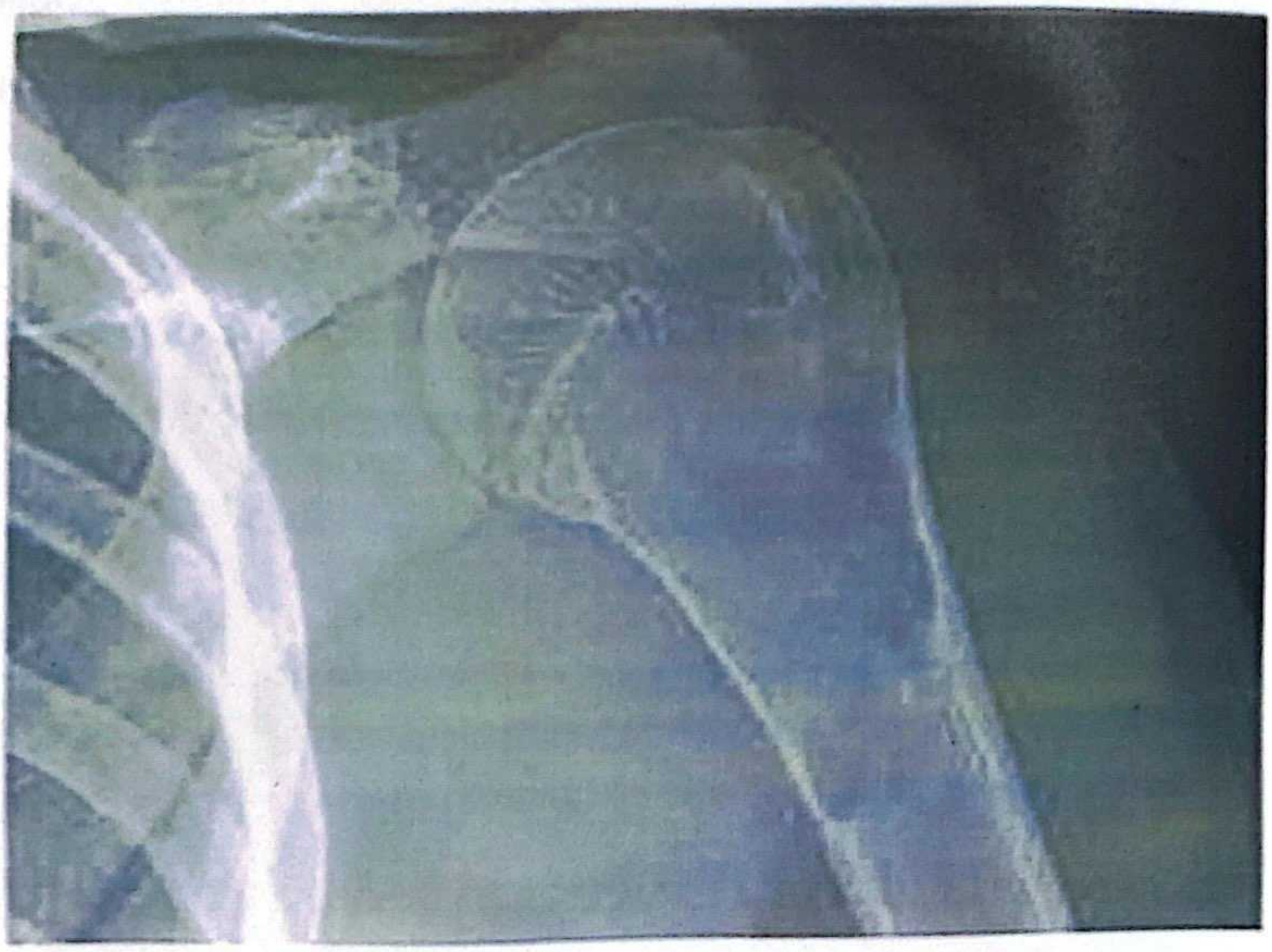
Usually there no fluid-fluid levels unless there has been a complication with hemorrhage.

Differential diagnosis

- fibrous dysplasia
- eosinophilic granuloma (EG)
- giant cell tumour of bone: usually older, extending to articular surface
- non ossifying fibroma: eccentric, cortical base
- haemophilic pseudotumour (intraosseous)
- aneurysmal bone cyst (ABC): usually eccentric



Q.9) **(2016)**



Identify: Plain Radiograph Shoulder AP projection

Describe:

- Well defined geographic, expansile lucent lesion with narrow zone of transition.
- Centrally located.
- Ground glass appearance
- No periosteal reaction or soft tissue component.
- No pathologic fracture/ fallen fragment.
- No Trabeculations.
- No calcified matrix.

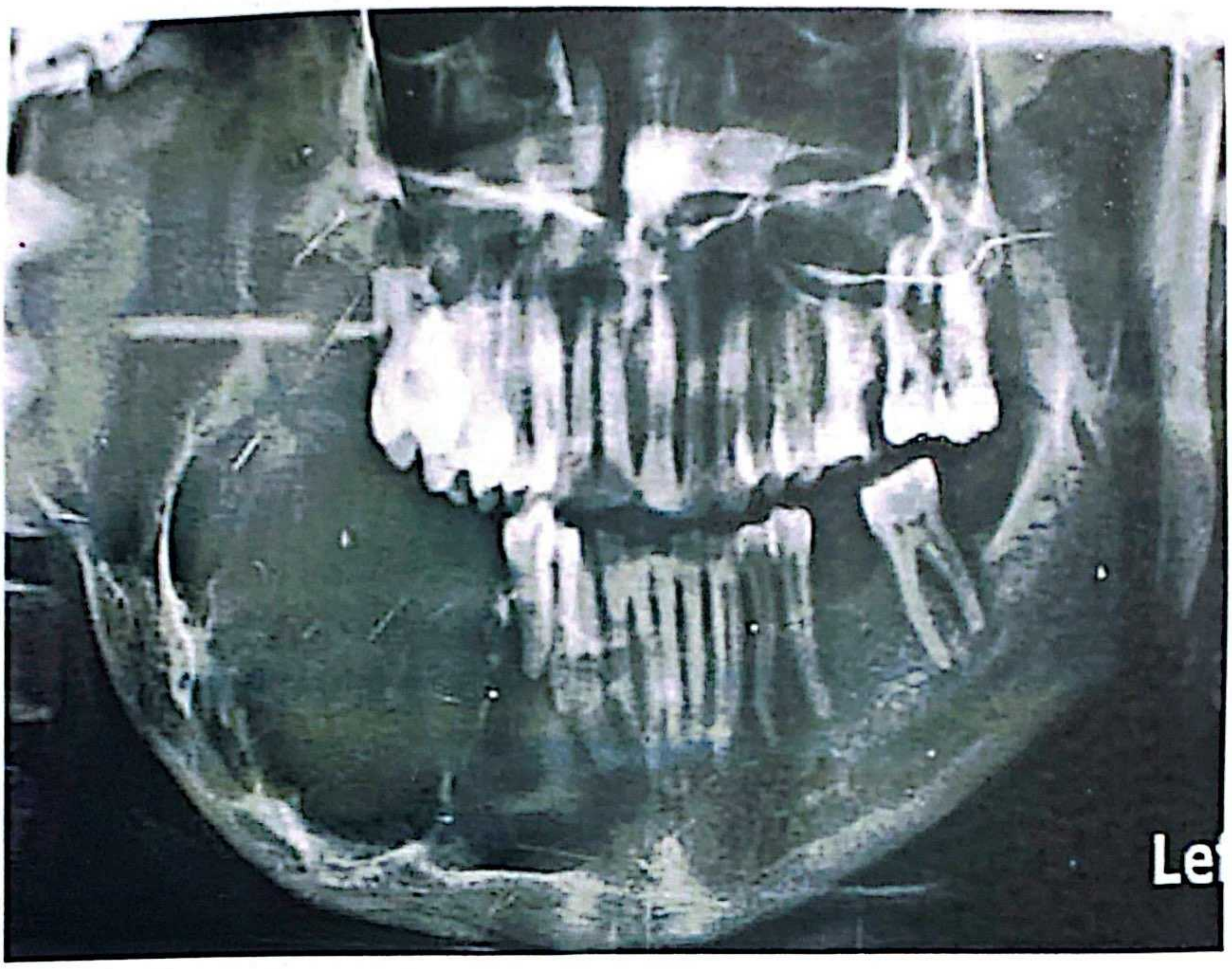
Diagnosis: Fibrous dysplasia

What next: MRI, Bone scintigraphy.

Differential Diagnosis:

- Eosinophilic granuloma (EG)
- Giant cell tumour of bone: usually older, extending to articular surface
- Non ossifying fibroma: eccentric, cortical base
- Haemophilic pseudotumour (intraosseous)
- Aneurysmal bone cyst (ABC): usually eccentric
- Brown tumor

Q.10) **(2016)**



Identify: Orthopantomogram (OPG)

Describe:

- Multiloculated , expansile "soap-bubble" lesion, with well-demarcated borders and no matrix calcification.
- Right body and ramus of mandible
- Erosion of the adjacent teeth highly specific. Eroding through cortex into adjacent soft tissues.

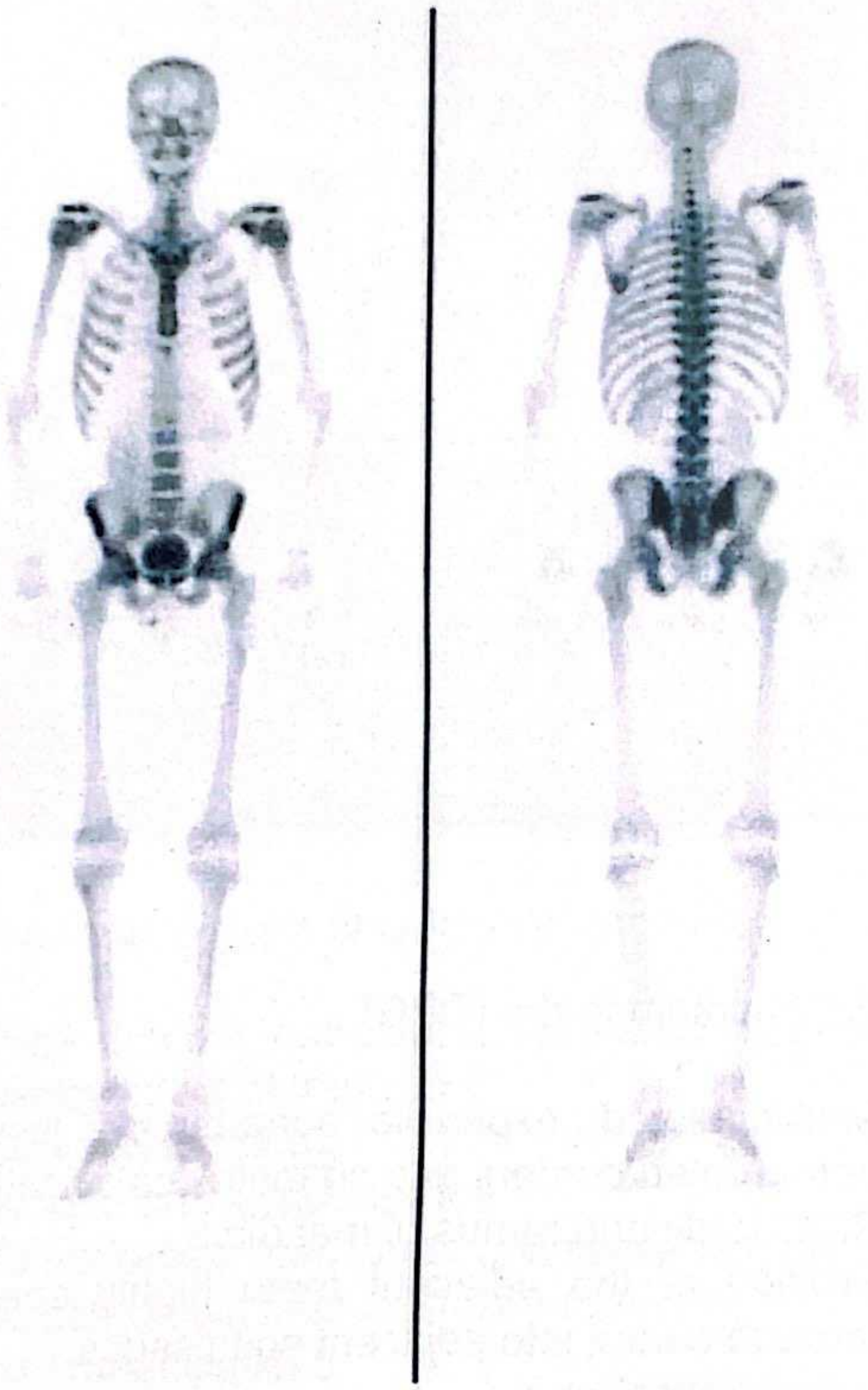
Diagnosis: Ameloblastoma

What next: CT scan, MRI, Bone scintigraphy, Biopsy/ Resection.

Differential Diagnosis:

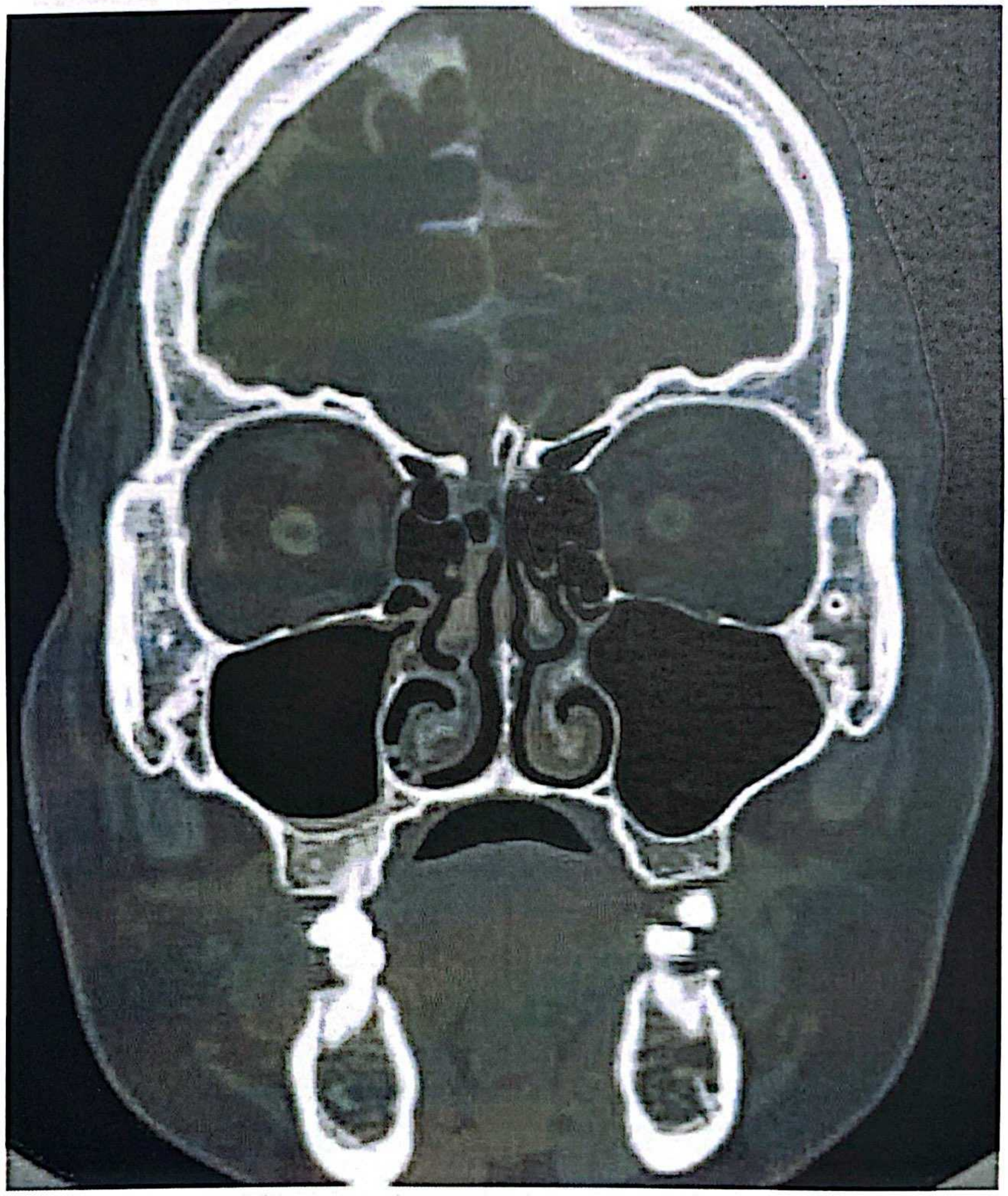
- Dentigerous cyst
- Odontogenic myxoma: can be almost indistinguishable
- Aneurysmal bone cyst (ABC)
- Fibrous dysplasia
- Multiple myeloma
- Brown tumor

Q.11) **(2016)**



Bone
Scintigraphy – Anterior and Posterior Projections
99m Technicium Methylene Diphosphonate
Standard: 500 MBq
SPECT : 740 – 800 MBq
Arterial – 1min post injection
Blood Pool – 5 min post injection
Delayed – more than or equal to 2 hours post injection

Q.12) (2016) (2018)



Identify: Bone defect is seen in the right cribriform plate.

Contrast leak and accumulation within the right maxillary antrum, anterior ethmoid air cells and nasal cavity.

CT cisternography is diagnostic modality for diagnosing occult site of CSF leak, it is performed after injecting contrast into thecal sac, and the patient is placed in a Trendelenburg position to opacify the basal cisterns, followed by CT imaging (thin-section coronal and axial CT images in both prone and supine positions) immediately after administration of contrast material.

Indications:

- CSF Rhinorrhea
- CSF Otorrhea

Pre-contrast CT is performed with thin slices

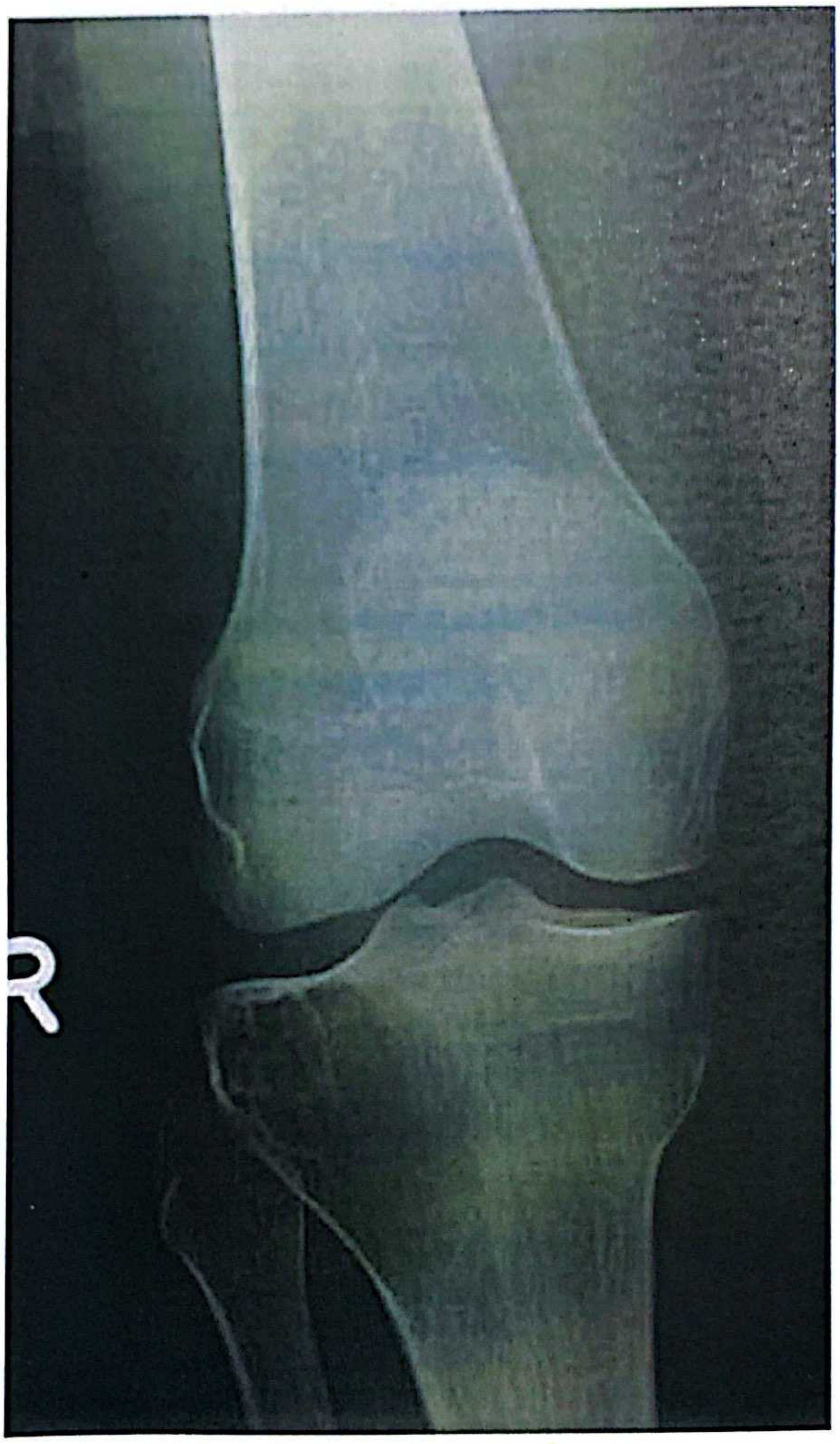
3-10 mL of an iodinated nonionic low-osmolar contrast agent is installed into thecal sac after lumbar puncture the patient is then tilted with foot-end elevation and a CT scan is performed with thin slices; maneuvers that provoke an active leak, such as head hanging or sneezing, are performed to visualize intermittent or occult leaks

Post-contrast images are then compared with the pre-contrast image to see where the CSF and the contrast are leaking out radionuclide cisternography is more sensitive but has poor anatomic resolution compared to CT cisternography

Complications:

- Bleeding
- Meningitis
- Arachnoiditis
- Pneumocephalus

Q.13) (2015) (2018)



Identify: Plain Radiograph Knee Joint AP Projection

Describe:

- Well circumscribed, expansile, sub articular, eccentric, solitary lytic lesion with a narrow zone of transition in the meta-epiphysis of proximal end of tibia.
- The lesion has characteristic soap bubble appearance with minimal marginal sclerosis.
- A cortical break is also seen of the anterior margin.
- Mild periosteal reaction along the lateral margin of the lesion is present.
- Overlying cortex appears thinned.

Diagnosis: Giant cell tumour of bone
What next: Bone scintigraphy, CT, MRI, Curettage and packing, Wide local excision

GIANT CELL TUMOR-OSTEOCLASTOMA-OSTEOBLASTOCLASTOMA-TUMOR OF MYELOPLEXUS-MYELOID SARCOMA

Nonmineralized lytic eccentric **meta epiphyseal lesion** involving a long bone with extension to subarticular bone in the skeletally mature patient
Origin: probably arise from zone of intense osteoclastic activity (of endochondral ossification) in skeletally immature patients
Age: peaks in 3rd decade
May be associated with:
Paget disease (in 50-60% located in skull+ facial bones)
Staging:

- Stage I indolent radiographic+ histologic appearance (10-15%)
- Stage 2 more aggressive radiographic appearance with expansile remodeling (70-80%)
- Stage 3 extension into adjacent soft tissues with histologically benign appearance (10-15%)

Location:
Long bones (75-85-90%)
Lower extremity (50-65% about knee): distal end of femur (23-30%) >proximal end of tibia (20-25%) >proximal femur (4%) >distal tibia (2-5%) >proximal fibula (3-4%) >foot (1-2%)
Flat bones (15%)
Pelvis: sacrum near SIJ (4%), iliac bone (3%) spine (3-6%): thoracic> cervical> lumbar spine (tumor frequency 2nd only to chordoma) rib (anterior I posterior end) skull (sphenoid bone)
Site: eccentric (42-93%) in metaphysis of long bones adjacent to ossified epiphyseal line; extension to within 1 cm of subarticular bone (84-99%) after fusion of epiphyseal plate (MOST TYPICAL) with possible trans articular spread

- The open epiphyseal plate acts as a barrier to tumor growth!
- Well-circumscribed expansile solitary lytic bone lesion with a narrow zone of transition:
- Wide zone of transition (10-20%)
- Large lesions are more centrally located

- **"soap bubble" appearance (47-60%)** = expansile remodeling with multiloculated appearance:
- NO internal mineralization of tumor matrix
- Prominent trabeculation (33-57%)
- No sclerosis (80-85%)
- Periosteal reaction (10-30%) due to aggressive rapid growth in absence of fracture
- Cortical penetration (33-50%):
- Cortical thinning
- Soft-tissue invasion (25%)
- Complete I incomplete pathologic fracture (11-37%)
- Destruction of vertebral body with secondary invasion of posterior elements
- Frequently vertebral collapse

NUC:

- **Diffusely increased uptake ± "doughnut" sign (57%)** of central photopenia on delayed bone scintigraphy
- Increased uptake across an articulation+ in adjacent joints (62%) due to increased blood flow+ disuse osteoporosis and NOT tumor extension

Angio:

- Hypervascular (60-65%) I hypovascular (20%) I avascular (10%) lesion

CT:

- Tumor of soft-tissue attenuation similar to muscle with foci of low attenuation (hemorrhage I necrosis)
- NO matrix mineralization
- Well-defined margins± thin rim of sclerosis (in up to 20%)
- Soft-tissue extension (33-44%) usually at metaphyseal end of tumor
- Aneurysmal bone cyst components (in 14%) of low density with fluid levels
- Joint involvement is unusual except for sacroiliac joint (38%) with sacral lesion
- Significant enhancement

MR:

- Relatively well-defined lesion of heterogeneous signal intensity with low to intermediate intensity on T1WI + T2WI

(63-96%) due to increased cellularity+ high collagen content+ hemosiderin

- HELPFUL feature to distinguish from other subarticular lesions (solitary subchondral cyst, intraosseous ganglion, Brodie abscess, clear cell chondrosarcoma with hyperintense matrix on T2WI)
- Focal aneurysmal bone cyst components (in 14%) in tumor center with marked hyperintensity on T2WI
- Direct biopsy to peripheral solid-tissue component to prevent misdiagnosis!
- Low-signal-intensity margin osseous sclerosis I pseudocapsule
- Significant enhancement of solid-tissue component

Malignant Giant Cell Tumor

Group of giant cell-containing lesions capable of malignant behavior + pulmonary metastases

Age: older than patients with benign GCTs

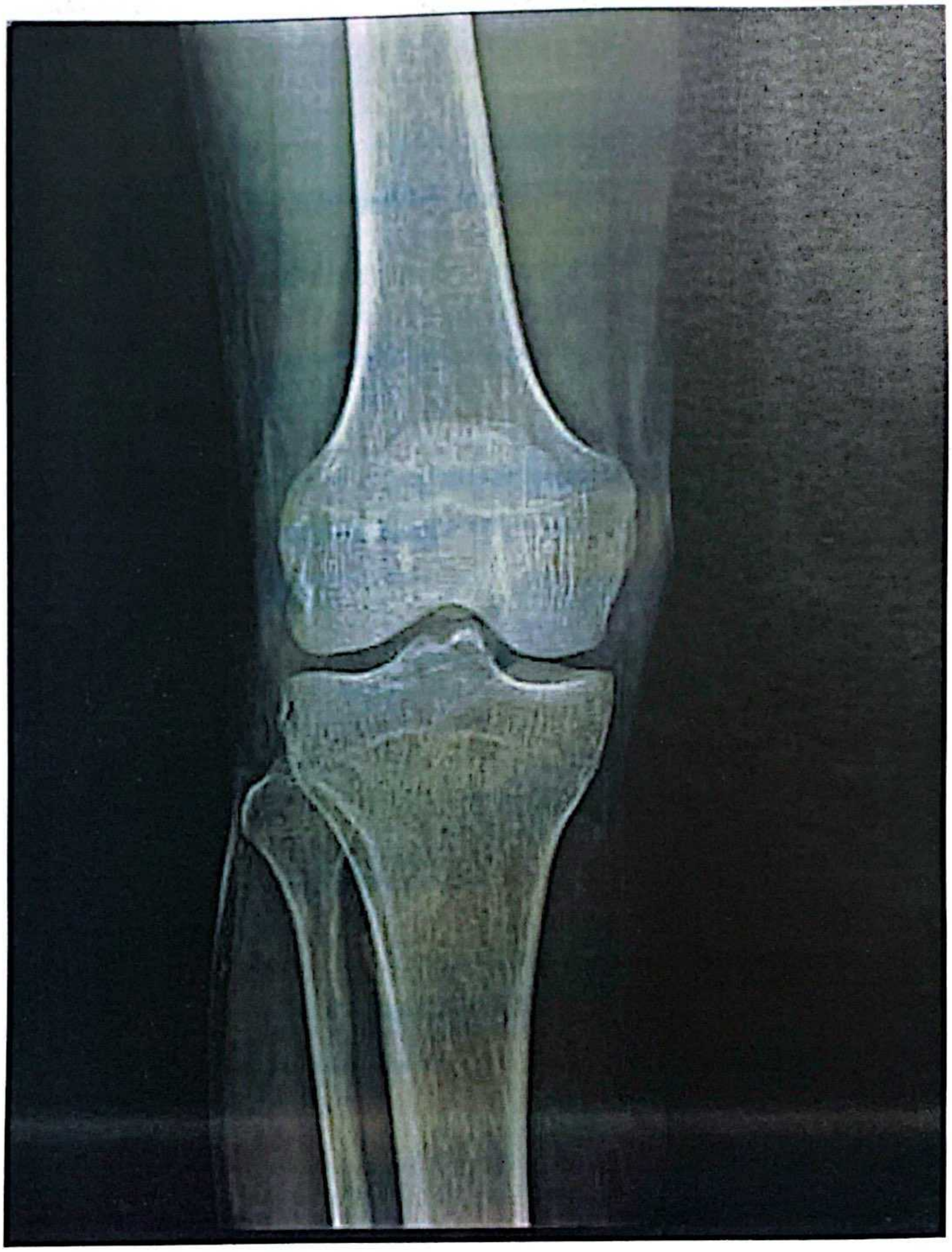
- Pulmonary metastases may remain stable I regress spontaneously
- Pulmonary nodules may show peripheral ossification

Differential diagnosis:

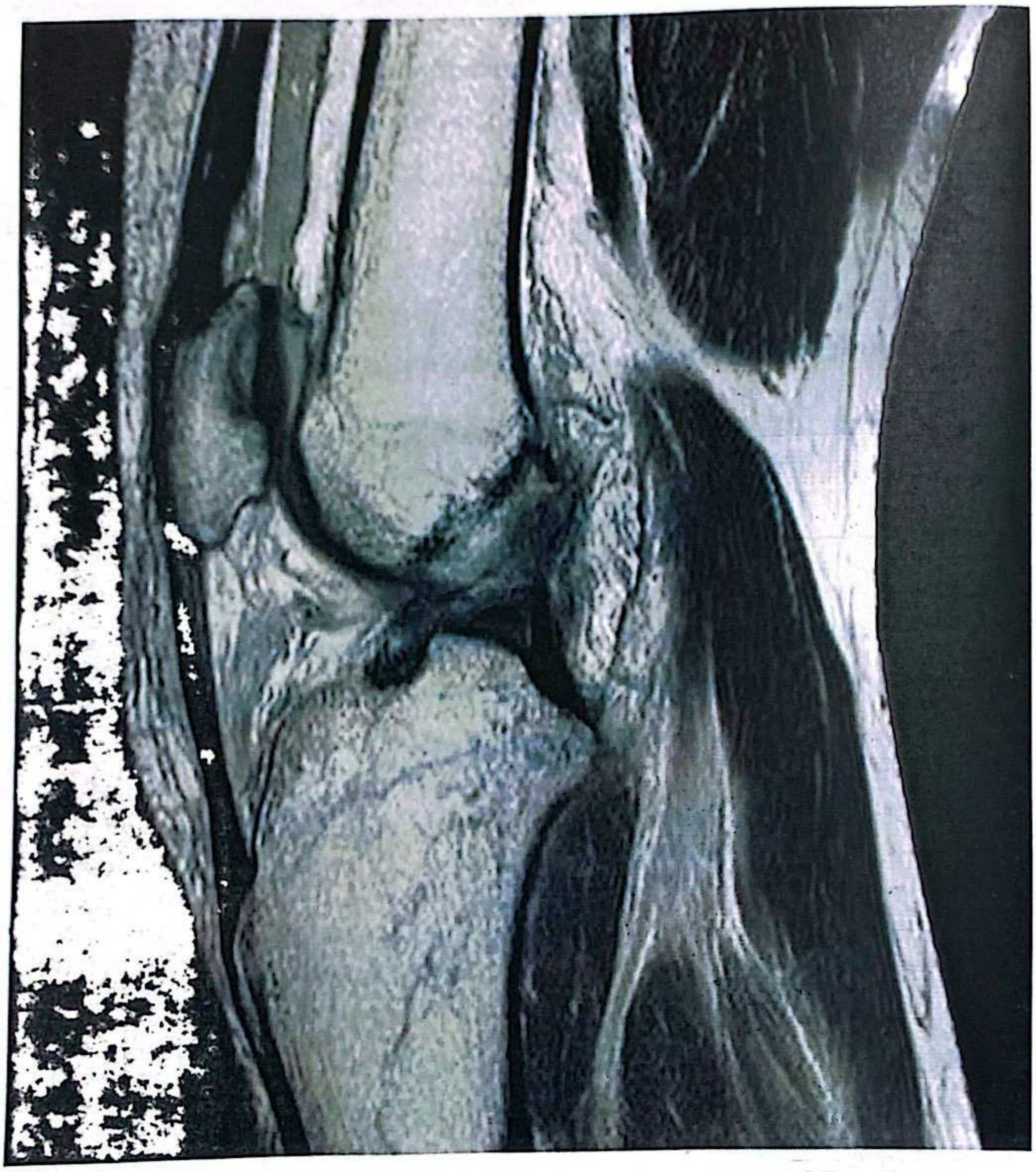
- chondroblastoma: epiphyseal, usually in skeletally immature patients
- chondromyxoid fibroma: metaphyseal, with a well defined sclerotic margin, multiloculated bubbly appearance 3
- aneurysmal bone cyst (ABC): younger age group, but may co-exist with GCT; fluid-fluid levels
- *non-ossifying fibroma*: usually younger age group 4
- *brown tumour: in the setting of hyperparathyroidism*
- enchondroma: *only really* a consideration in lesions of small bones of the hand and foot
- haemophilic pseudotumour
- chondrosarcoma: typically older age group
- metastases and multiple myeloma
- intraosseous ganglion cysts
- desmoplastic fibroma

Q.14) (2015)

Trauma

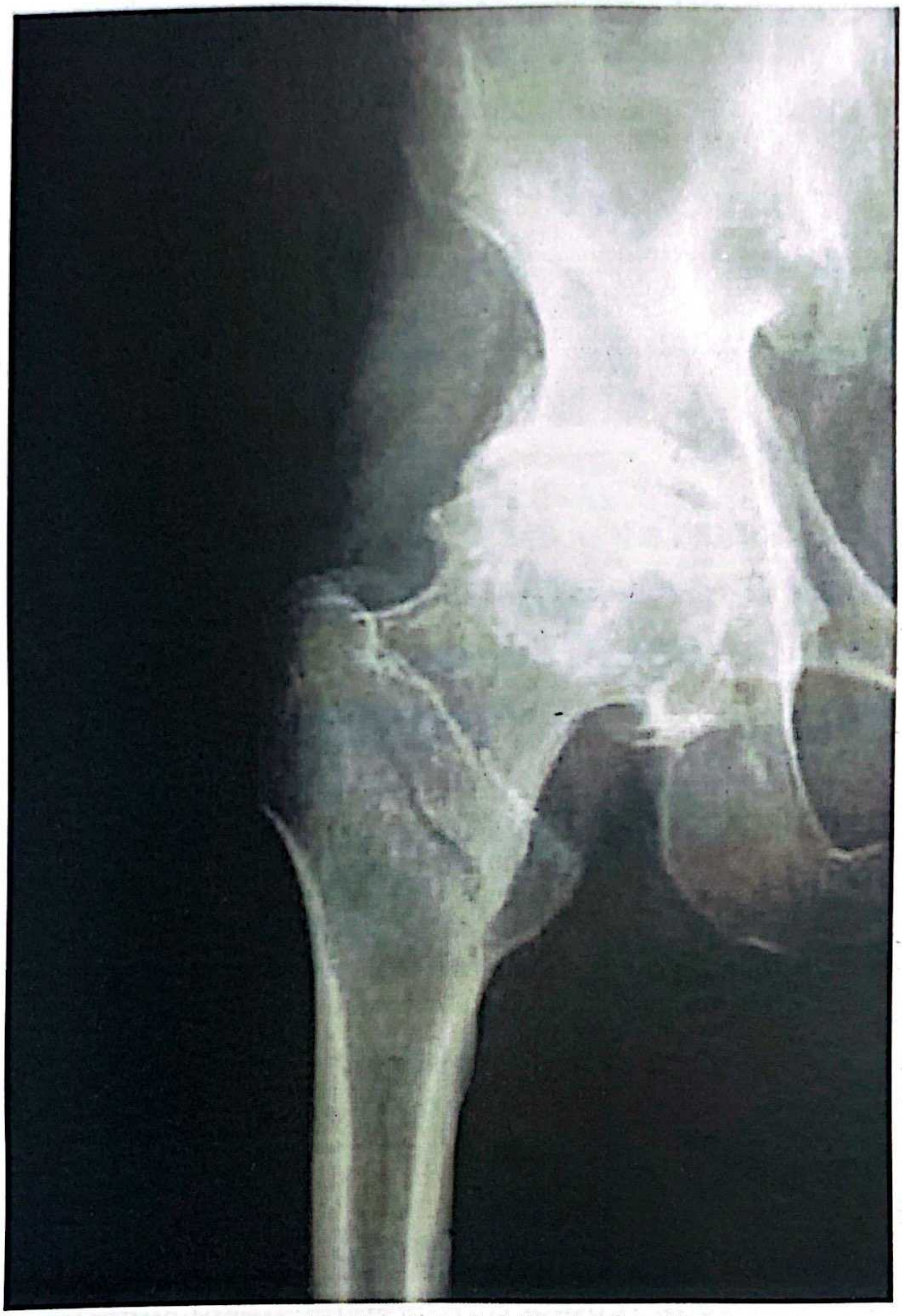


There is a linear bone fragment adjacent to the lateral margin of the lateral tibial plateau, consistent with a segond fracture.



MRI sequences showing the complete tear of the anterior cruciate ligament associated with joint effusion, bone marrow oedema in the dorsal tibial plateau and lateral femoral condyle, as well as local subcutaneous oedema. There is also a cortical disruption on the posterolateral aspect of the tibial plateau which is in keeping with a Segond fracture.

Q.15) (2014)



Identify: Plain Radiograph Hip Joint AP Projection

Describe:

- There is ill-defined mixed sclerotic and lytic lesion of the left femoral head.
- Additional cortical collapse of the superior aspect of the femoral head is noted with a linear area of lucency below it (crescent sign)
- Diffuse osteopenia.
- Old displaced intertrochanteric fracture of the right femur with early callus formation.
- Flattened deformed femoral head

Diagnosis: Avascular necrosis of the hip

What next: MRI, Bone Scan

MRI

MRI is the most sensitive modality

T1: Usually the initial specific findings are areas of low intensities represent oedema, which can be bordered by a hyper-intense line which represents blood products

T2: It may show a second hyper-intense inner line between normal marrow and ischaemic marrow. This appearance is highly specific for AVN hip and known as "double line sign"

Differential diagnosis

- haematopoietic marrow (see bone marrow)
- Pitt's pit
- fovea centralis
- idiopathic transient osteoporosis of the hip (ITOH)
- hyperaemia with diffuse increased uptake of radiotracer by the femoral head, neck, and intertrochanteric region
- chondroblastoma
- fracture
- infection
- pain and fever
- usually involves both sides of the joint
- metastases

The Ficat and Arlet classification

Stage I

Plain radiograph: normal or minor osteopenia
MRI: oedema
Bone scan: increased uptake

Stage II

Plain radiograph: mixed osteopenia and/or sclerosis and/or subchondral cysts, without any subchondral lucency (crescent sign: see below)
MRI: geographic defect
Bone scan: increased uptake

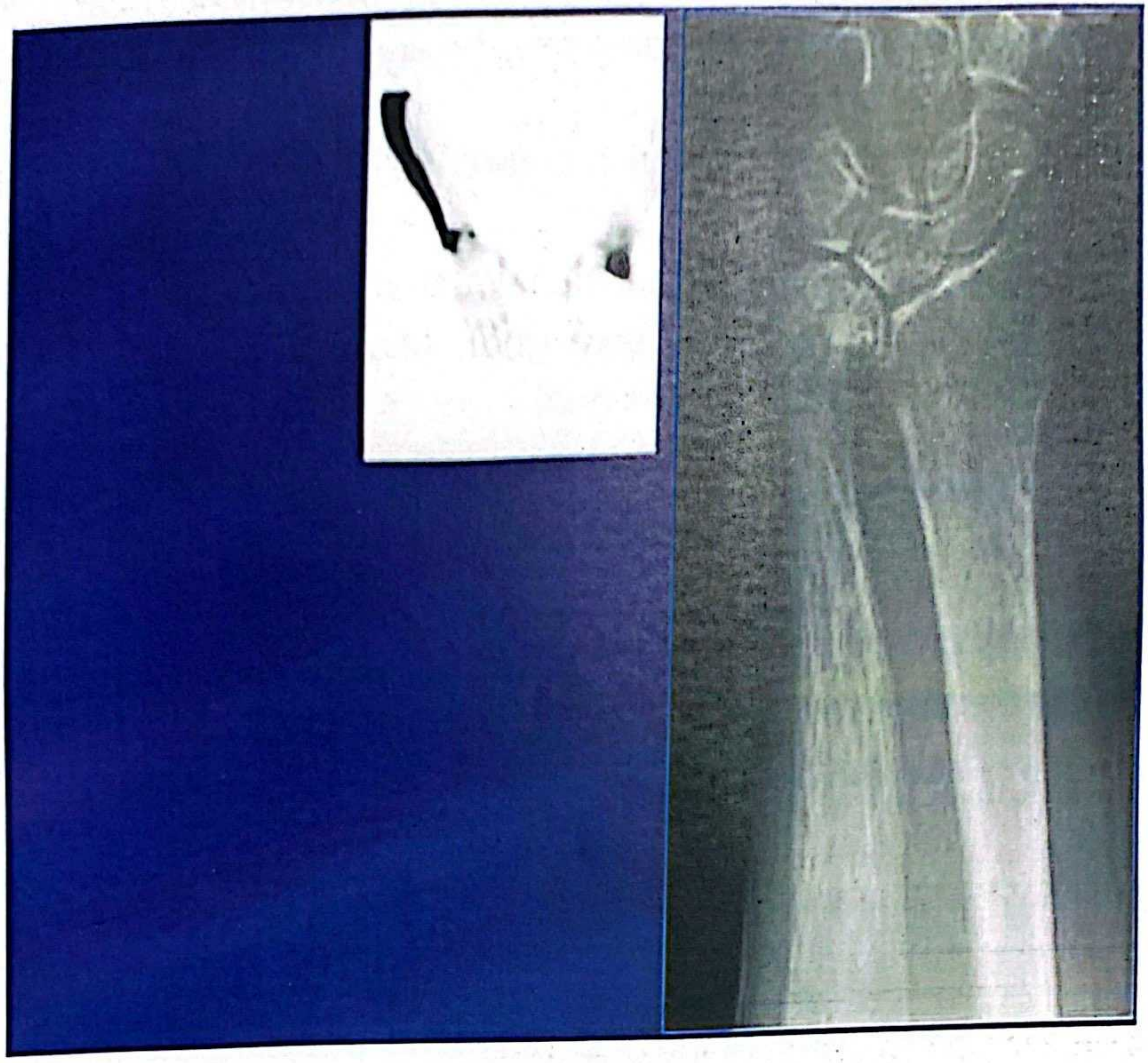
Stage III

Plain radiograph: crescent sign and eventual cortical collapse
MRI: same as plain radiograph

Stage IV

Plain radiograph: end-stage with evidence of secondary degenerative change
MRI: same as plain radiograph

Q.16) **(2014)**



Identify: Plain Radiograph Wrist joint, Distal, Ulna and Radius, AP View

Describe:

- Diffuse enlarged ulna with increased bone density
- Ground glass appearance and coarse trabeculae
- Loss of medullary cavity
- Lesion is surrounded by a layer of thick, sclerotic reactive bone- Rind sign
- No periosteal reaction

Diagnosis: Fibrous dysplasia

What next: CT, MRI, Bone Scan, Surgical decompression

CT

- Ground-glass opacities
- Homogeneously sclerotic
- Cystic

- Well-defined borders
- Expansion of the bone, with intact overlying bone
- Endosteal scalloping may be seen

MRI

MRI is not particularly useful in differentiating fibrous dysplasia from other entities

- T1: heterogeneous signal, usually intermediate
- T2: heterogeneous signal, usually low, but may have regions of higher signal
- T1 C+ (Gd): heterogeneous contrast enhancement

Nuclear Medicine

Demonstrates increased tracer uptake on Tc99 bone scans (lesions remain metabolically active into adulthood).

Treatment

Surgical decompression may be considered.

Complications

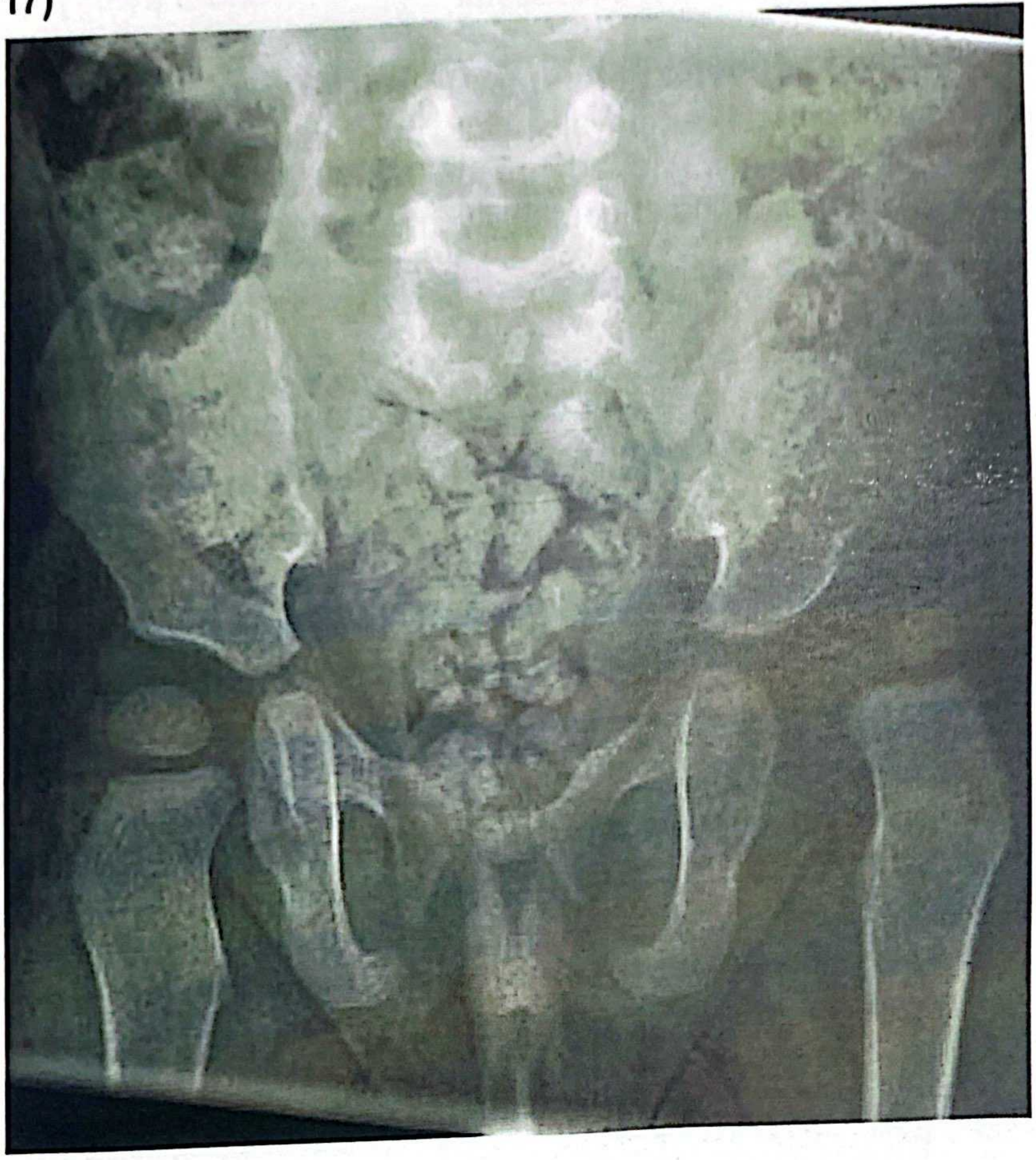
Susceptible to pathological fractures.

Differential diagnosis

- Paget disease
- Osteofibrous dysplasia
- Adamantinoma
- Non-ossifying fibroma
- Simple bone cyst
- Giant cell tumour
- Enchondromatosis

(2014)

Q.17)



Identify: Plain Radiograph Both Hip Joints AP View

Describe: Dislocated left hip with asymmetrically sized femoral epiphysis (left is smaller) and underdeveloped, shallow left acetabulum.

The case shows Puttis's triad:

- Increased acetabular triangle.
- Small epiphysis due to ossification.
- Superolateral displacement (superior to Hilgenreiner's line and lateral to Perkin's line).

Diagnosis: Developmental dysplasia of the hip

What next: Ultrasound

Management options include:

- Pavlik harness: usually for younger patients (less than six months of age)
- closed reduction: usually for older patients

- open reduction (ORIF): much older patient or if closed reduction not successful

Ultrasound is the test of choice in the infant (<6 months) as the proximal femoral epiphysis has not yet significantly ossified. Additionally, it has the advantage of being a real-time dynamic examination allowing the stability of the hip to be assessed with stress views.

Alpha angle

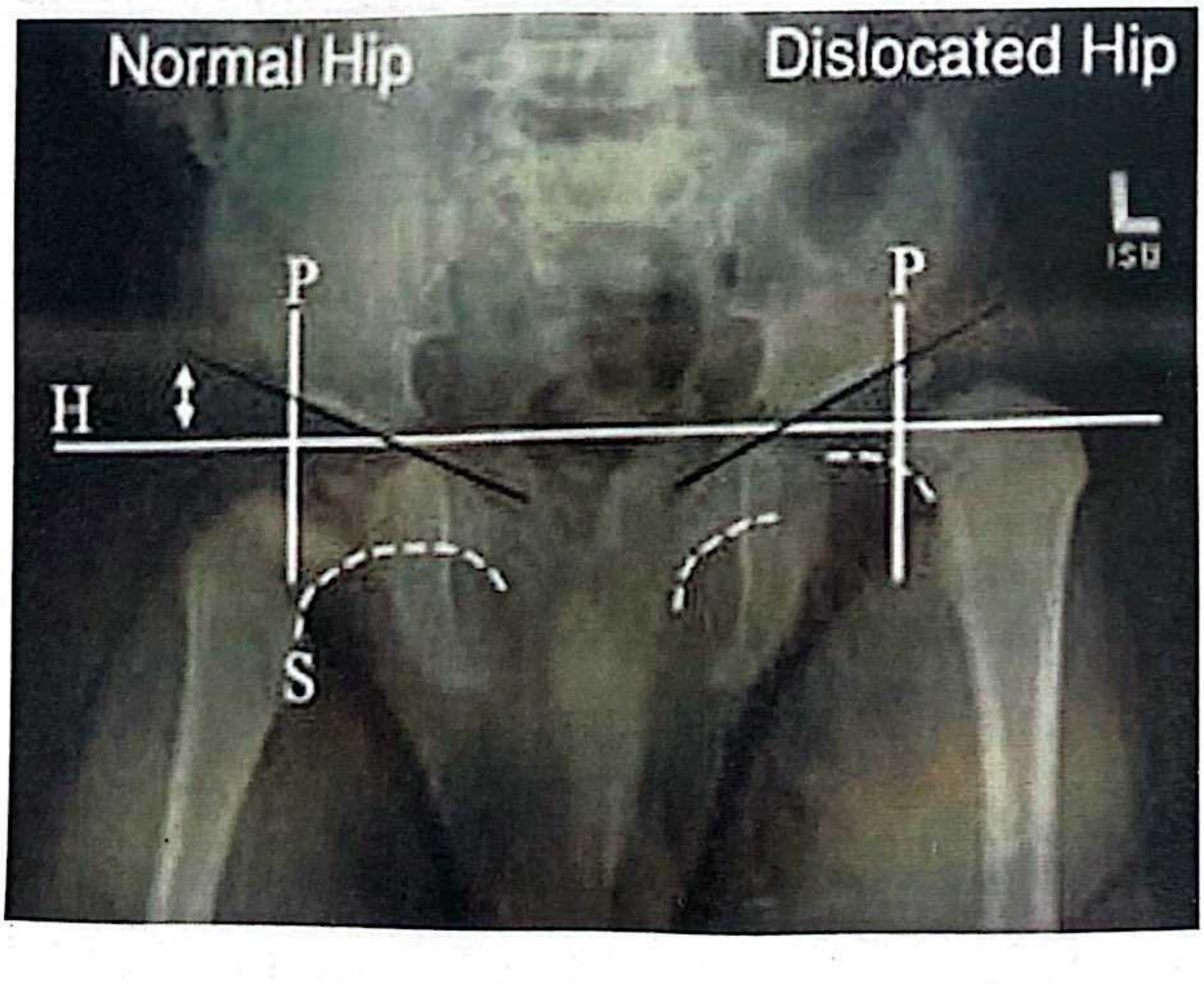
The alpha angle is formed by the acetabular roof to the vertical cortex of the ilium. This is a similar measurement as that of the acetabular angle (see below). The normal value is greater than or equal to 60°.

Beta angle

The beta angle is formed by the vertical cortex of the ilium and the triangular labral fibrocartilage (echogenic triangle). The normal value is less than 77° 6 but is only useful in assessing immature hips when combined with the alpha angle.

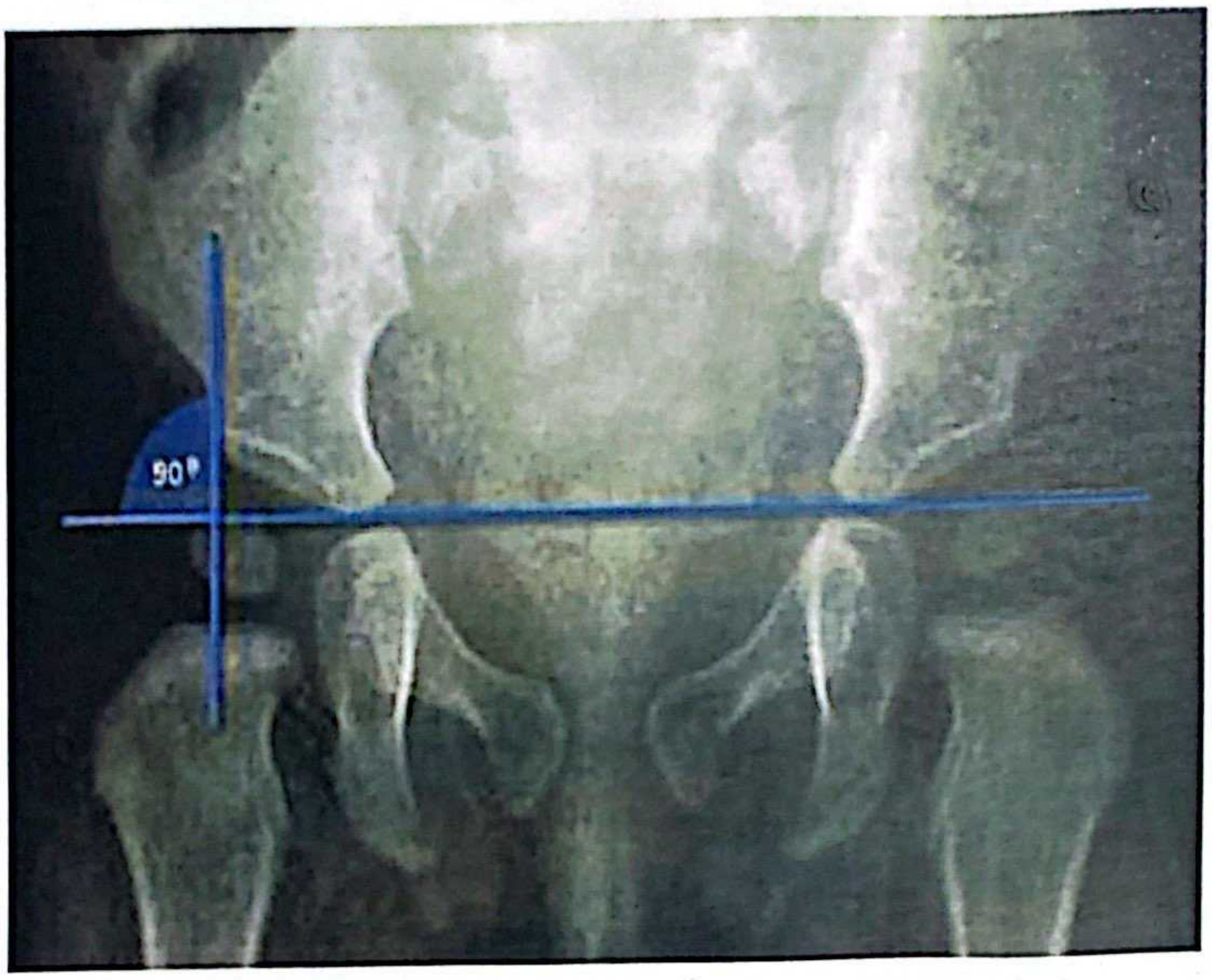
Bony coverage

The percentage of the femoral epiphysis covered by the acetabular roof. A value of >50% is considered normal

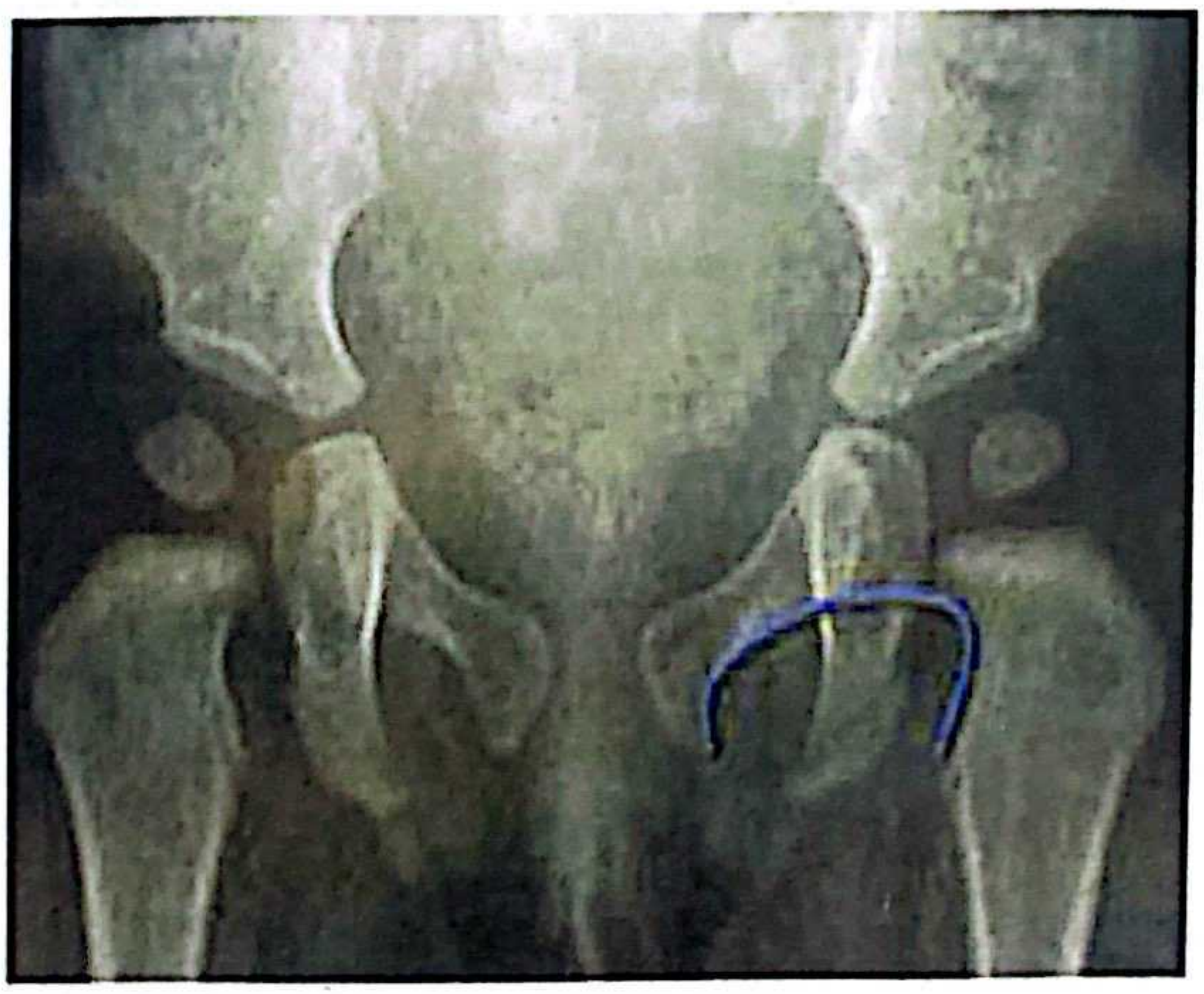


Risk factors include:

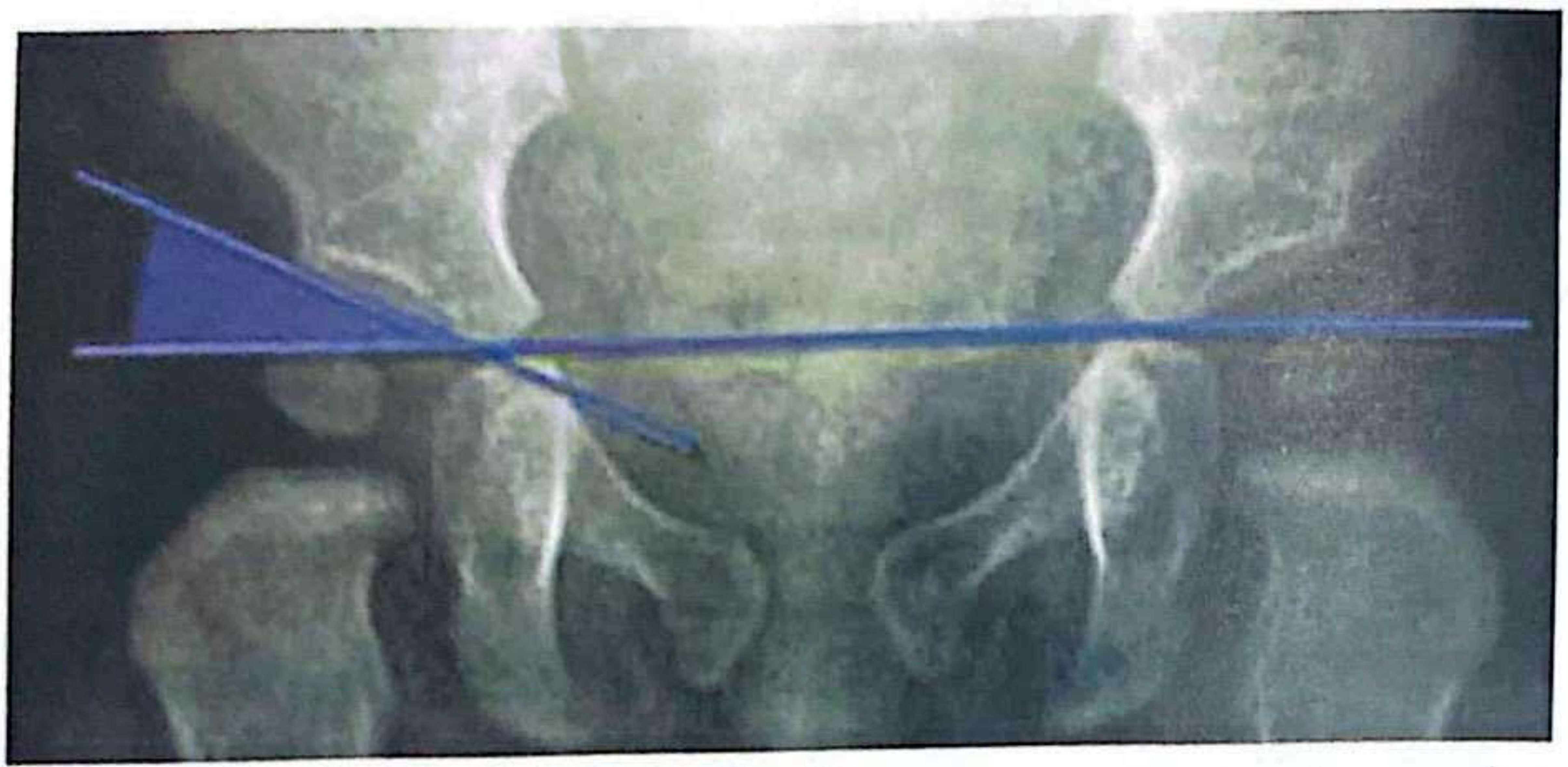
- female gender (M:F ratio 1:8)
- firstborn baby
- family history
- breech presentation
- oligohydramnios
- metatarsus adductus



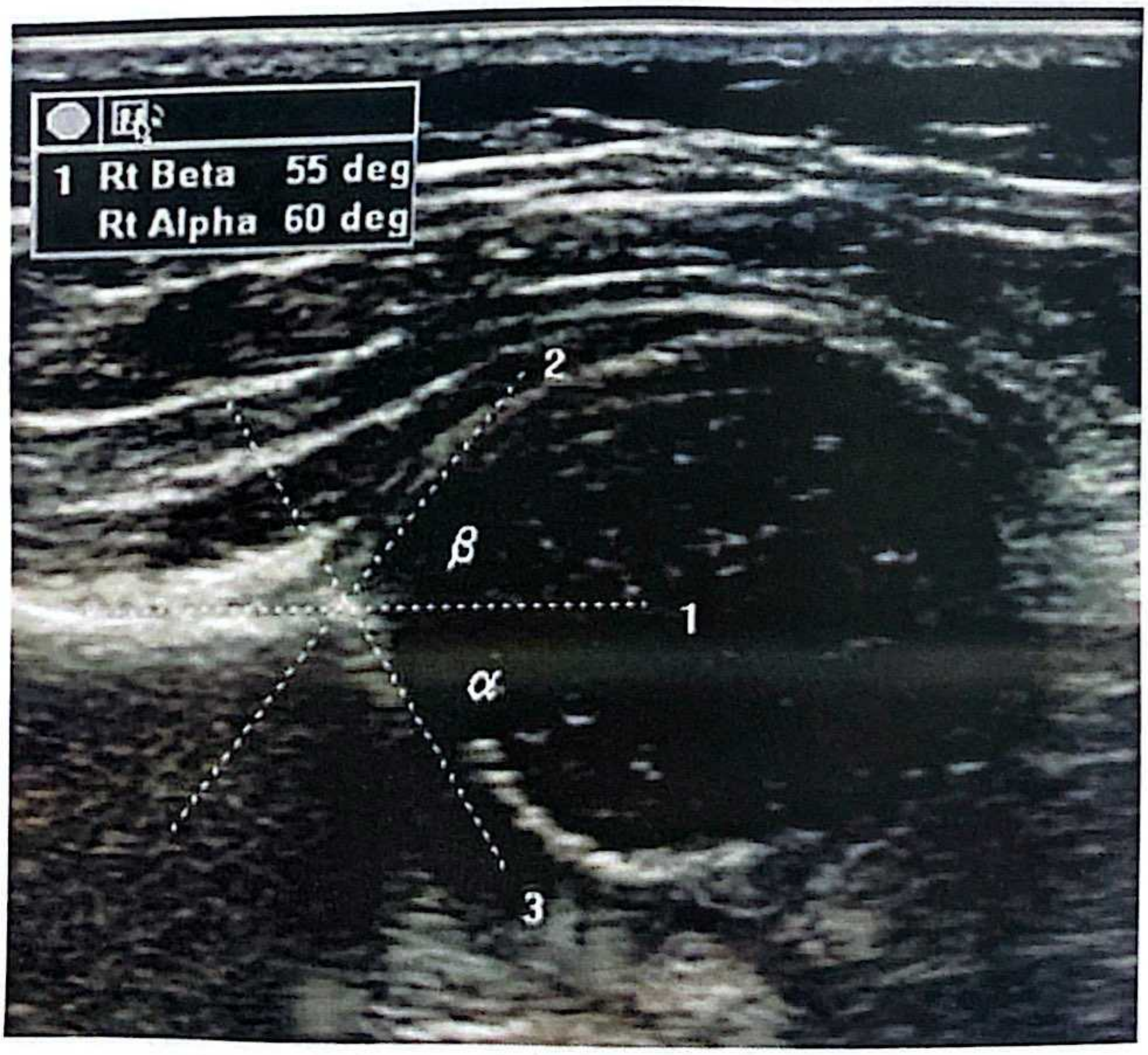
Perkin's line is drawn vertically though the lateral most aspect of the acetabular roof, perpendicular to Hilgenreiner's line. The ossified femoral head should be in the inferomedial quadrant created.



Shenton line along the inferior aspect of the superior pubic ramus and the inferiomedial femoral neck.

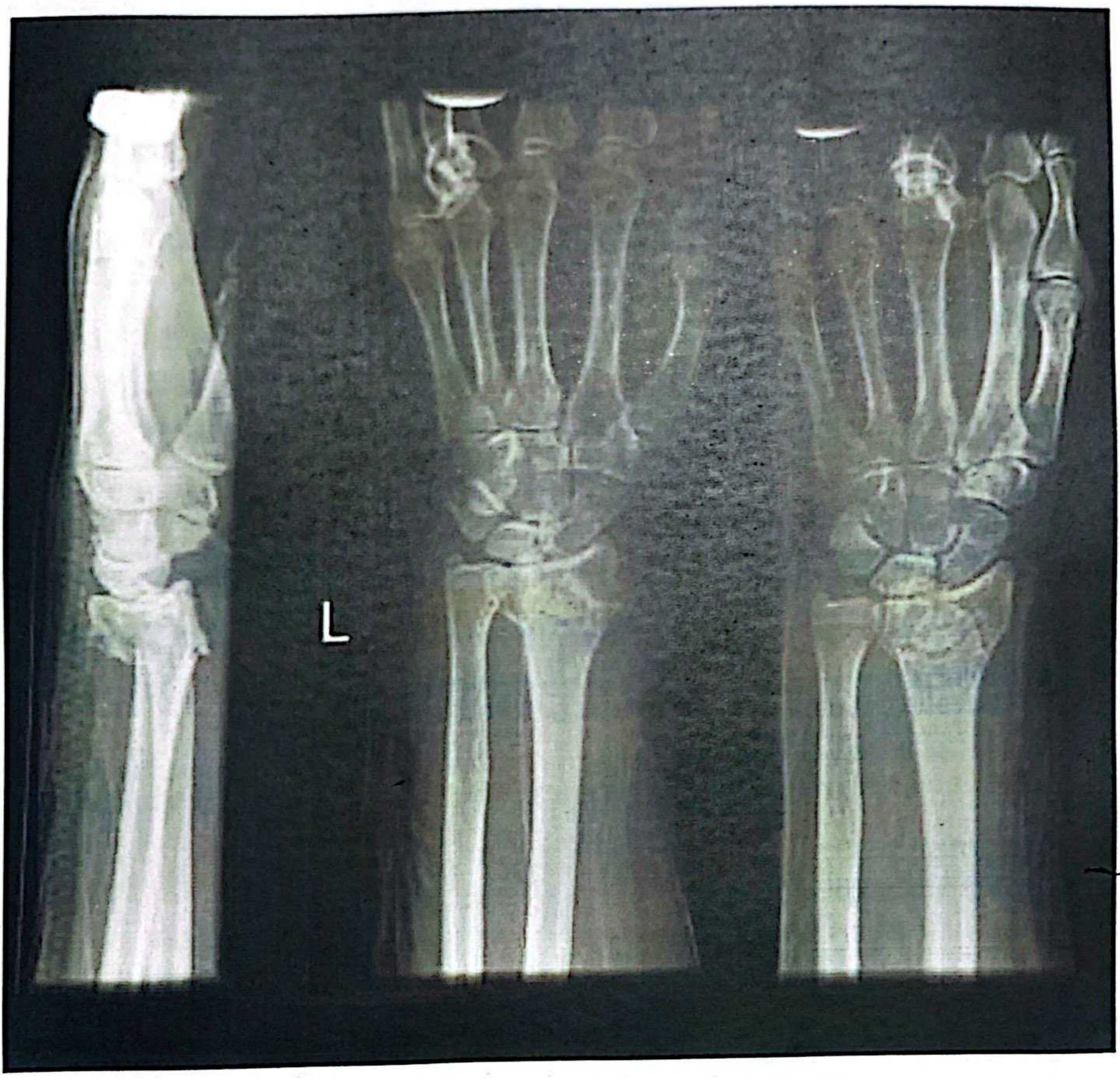


The acetabular angle is a plain film measurement used when evaluating developmental dysplasia of the hip (DDH) which is measured between Hilgenreiner's line and a line parallel to the acetabular roof. At birth it should be less than 28 degrees and should progressively reduce with maturation of the hip.



Normal infant hip ultrasound

Q.18) **(2013)**



Identify: Plain X-Ray Lateral and AP View Wrist Joint

Describe: Transverse extra-articular distal radius fracture with dorsal angulation.

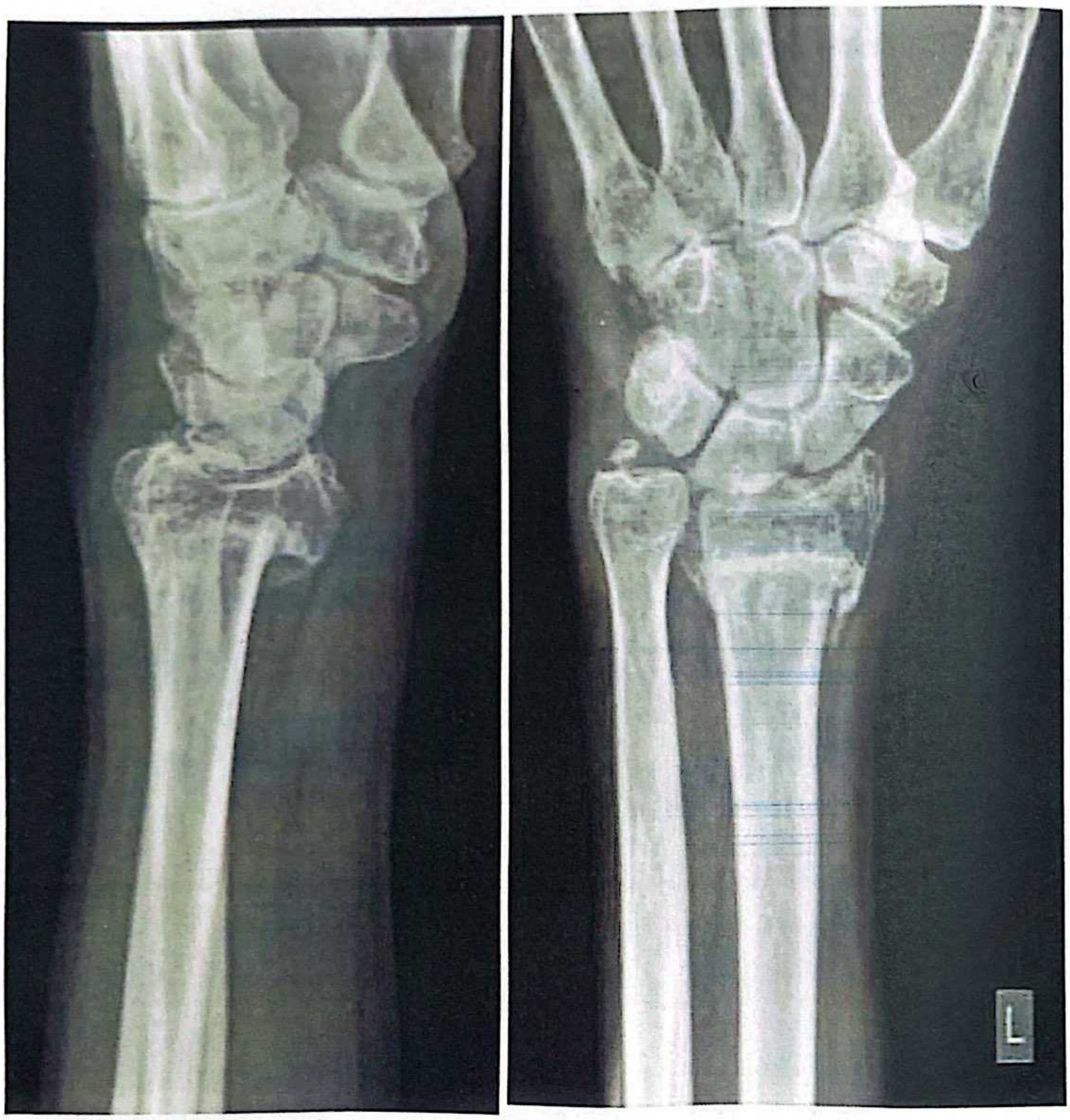
Diagnosis: Colles fracture

What next: Closed reduction and cast immobilization

Complications:

- Malunion resulting in dinner fork deformity
- Median nerve palsy and post-traumatic carpal tunnel syndrome
- Reflex sympathetic dystrophy
- Secondary osteoarthritis, more frequently seen in patients with intra-articular involvement
- EPL tendon tear

Q.19) (2014)



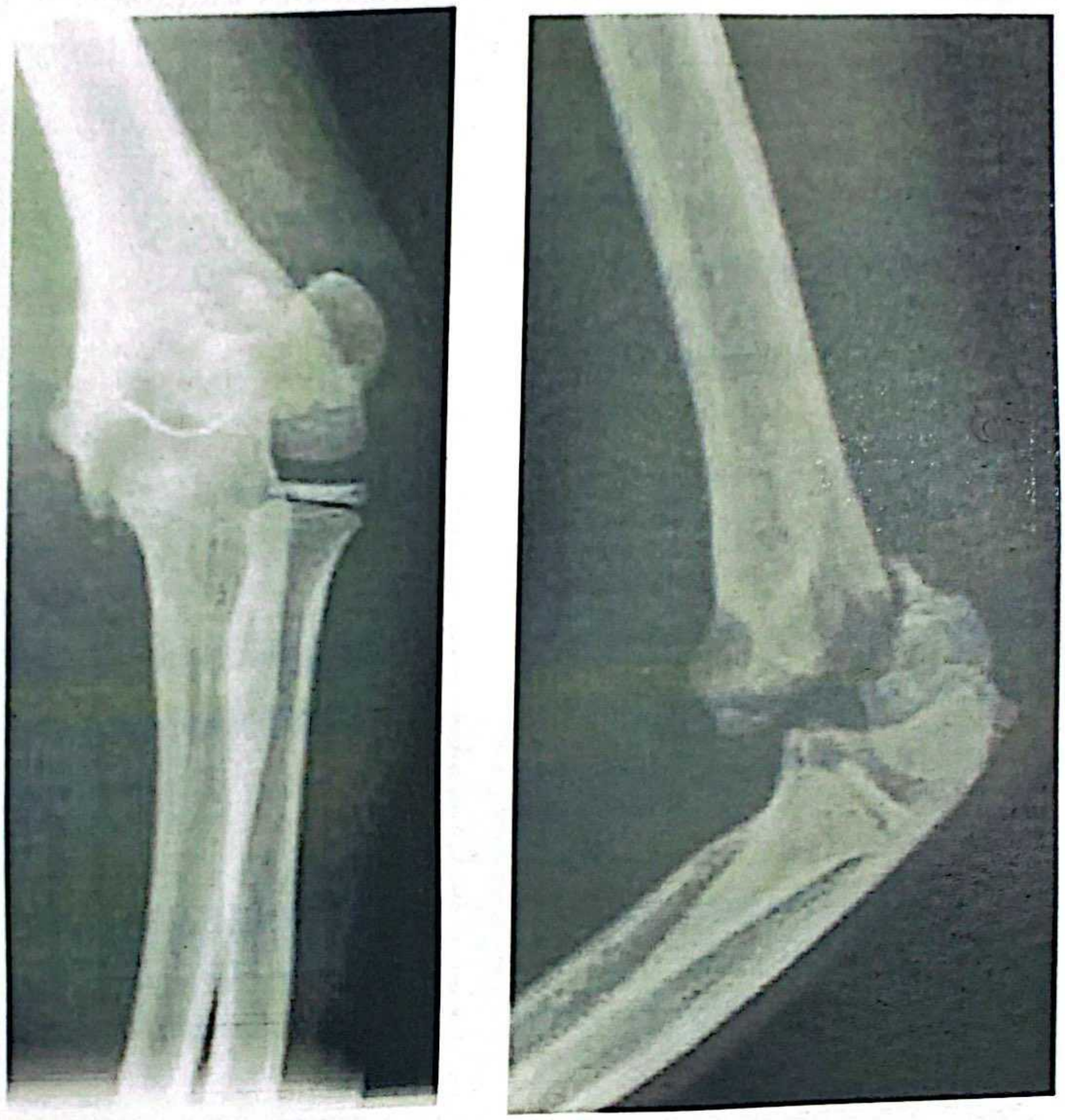
Identify: Plain X-Ray Lateral and AP View Wrist Joint

Describe: Impacted fracture of the distal radius with palmar angulation and evidence of intra-articular involvement. There is also ulnar styloid fracture.

Diagnosis: Smith fracture

What next: Closed reduction and cast application

Q.20) **(2015)**



Identify: Plain X-Ray AP Lateral and AP View Elbow Joint

Describe: Complete supracondylar fracture with posterior and lateral displacement. Joint effusion. No elbow joint dislocation

What next:

Plain radiograph

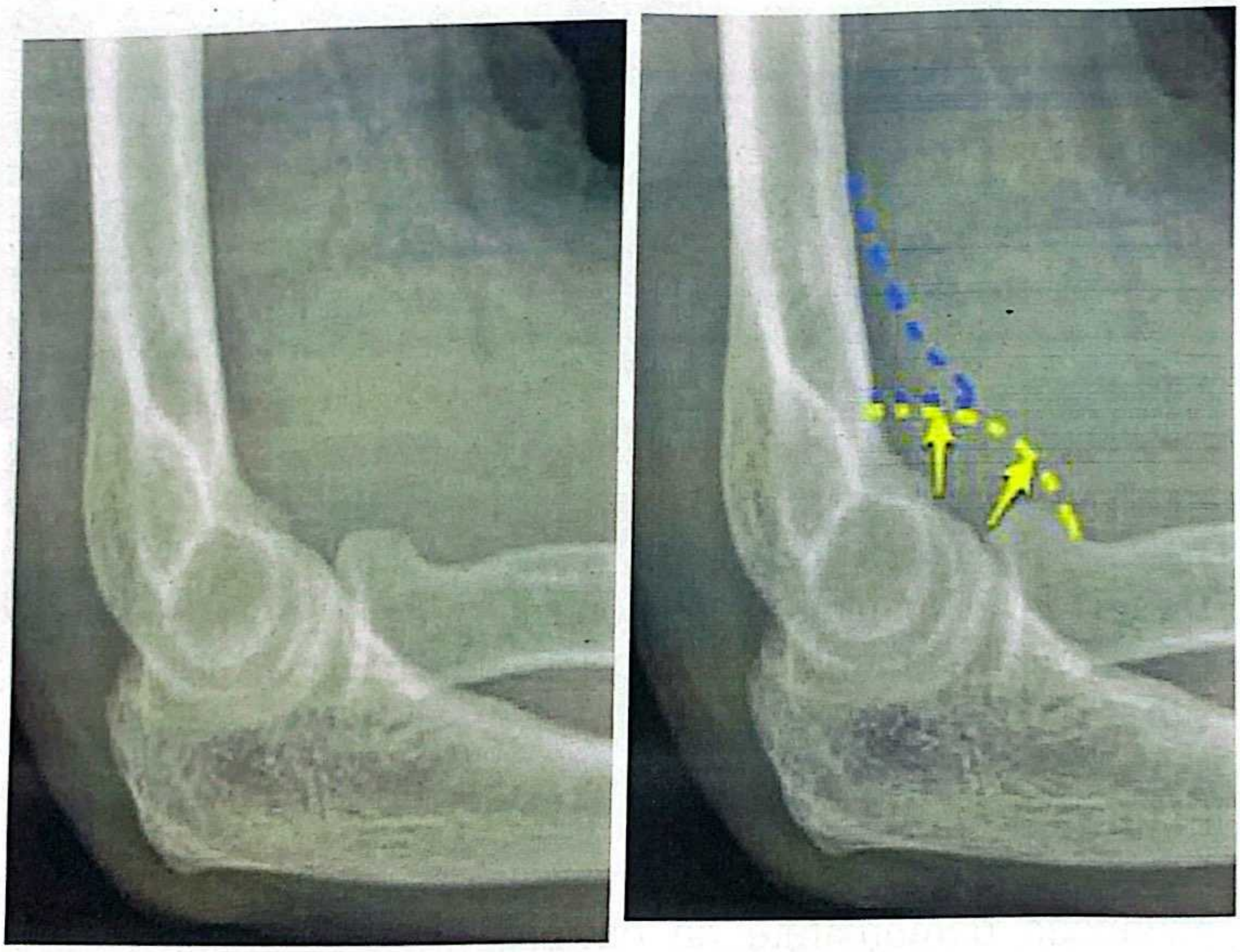
Lateral and AP radiographs are usually sufficient, and in many instances demonstrate an obvious fracture. Often, however, no fracture line can be identified. In such cases assessing for indirect signs is essential:

Anterior fat pad sign (sail sign): the anterior fat pad is elevated by a joint effusion and appears as a lucent triangle on the lateral projection

Posterior fat pad sign
anterior humeral line should intersect the middle third of the capitellum in most children 2 although, in children under 4, the anterior humeral line may pass through the anterior third without injury

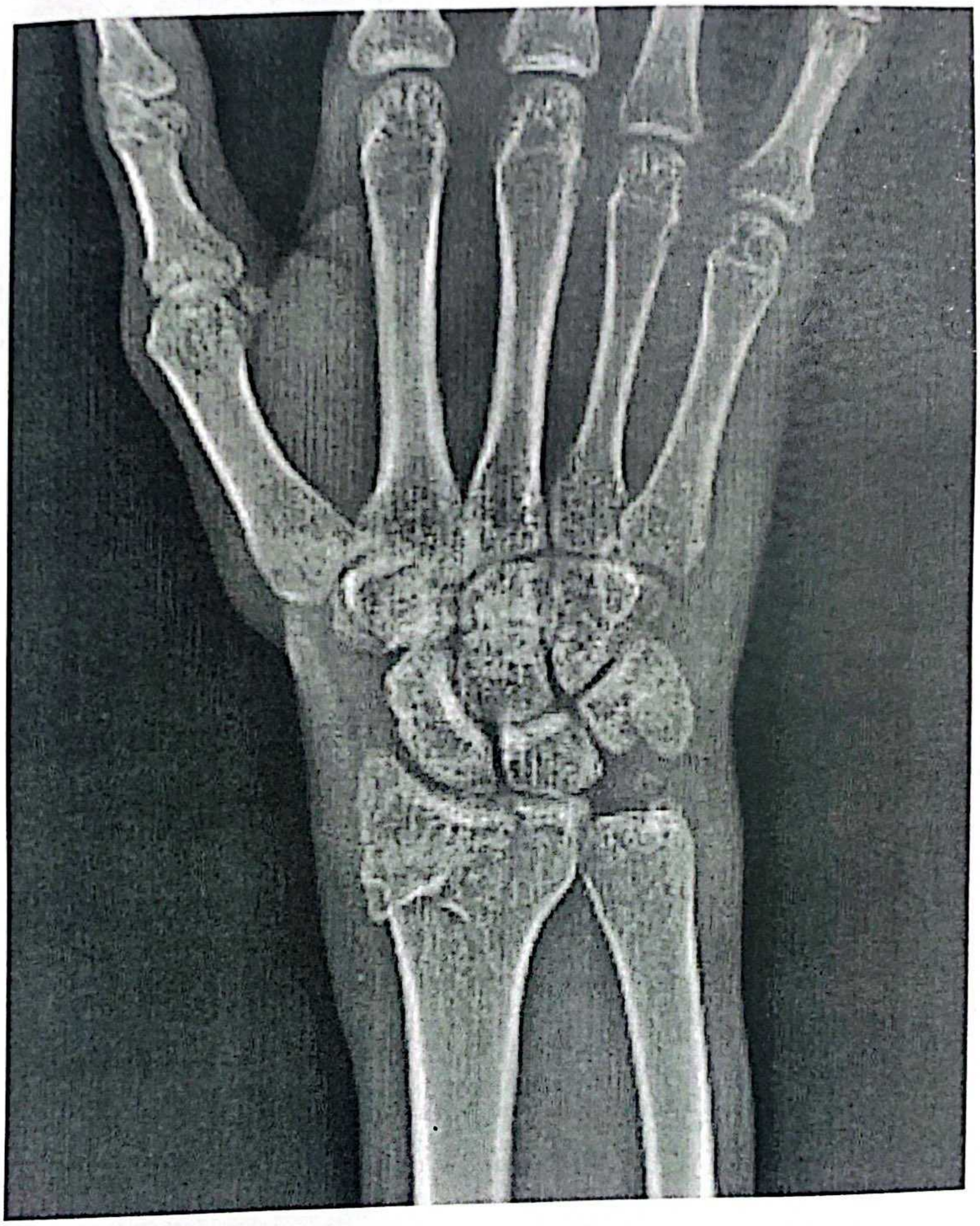
Complications

1. Malunion: resulting in cubitus varus (varus deformity of the elbow, also known as gunstock deformity)
2. Ischaemic contracture (Volkmann contracture) due to damage/occlusion to the brachial artery and resulting in volar compartment syndrome
3. Damage to the ulnar nerve (most common), median nerve, or radial nerve
4. Fishtail deformity



The anterior fat pad sign, also known as the sail sign or spinnaker sign is the result of a joint effusion (yellow) elevating the normal anterior fat pad up and out of its normal location in the concavity of the humerus, which takes on a triangular shape (blue) on lateral projection

Q.21) **(2014)**



Identify: Plain X-Ray AP View Wrist Joint

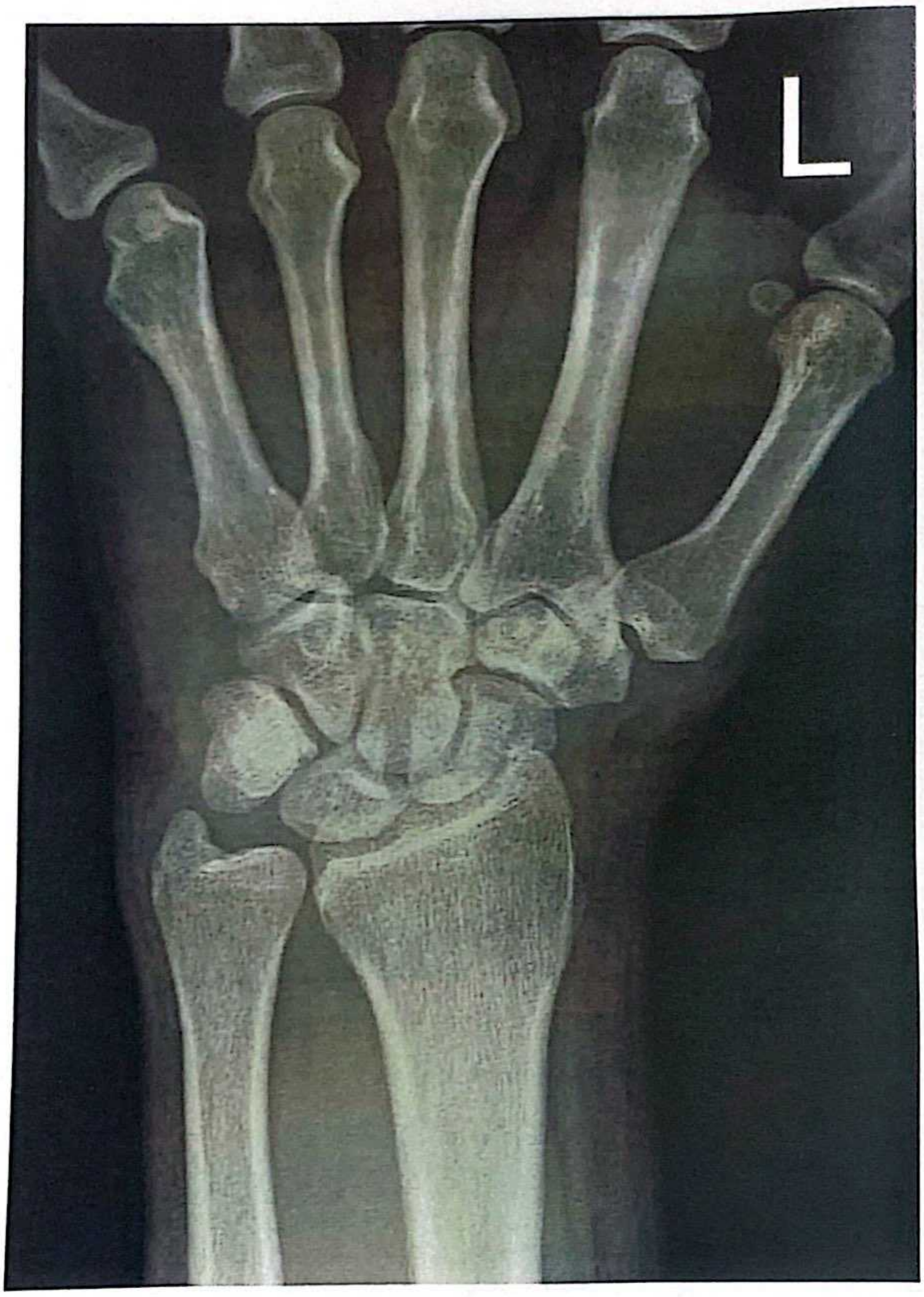
Describe:

1. Distal radial fracture
2. fracture extends to intrarticular surface along dorsal aspect
3. volar surface is not involved

Diagnosis: Barton fracture

What next: Cast application

Q.22) (2013)



Identify: Plain X-Ray AP View Wrist Joint

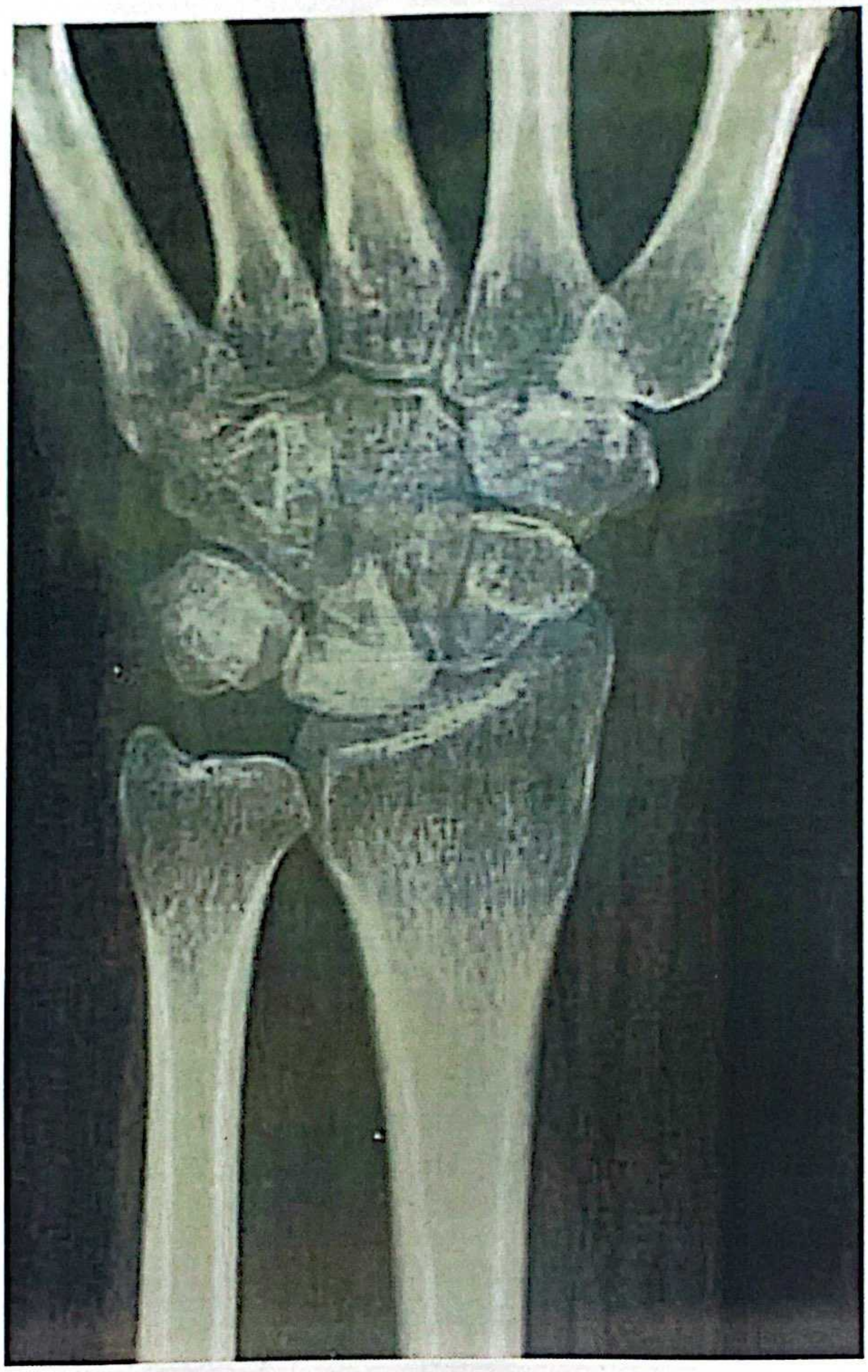
Describe: The scaphoid waist fracture demonstrates loss of normal alignment, with new displacement since the initial radiographs.There is subtle new sclerosis within the proximal pole

Diagnosis: Scaphoid avascular necrosis

What next: Conservative management with rest, non-steroidal anti-inflammatory drugs and immobilisation in mild cases is often very effective

Q.23) **(2016)**

Atraumatic wrist pain



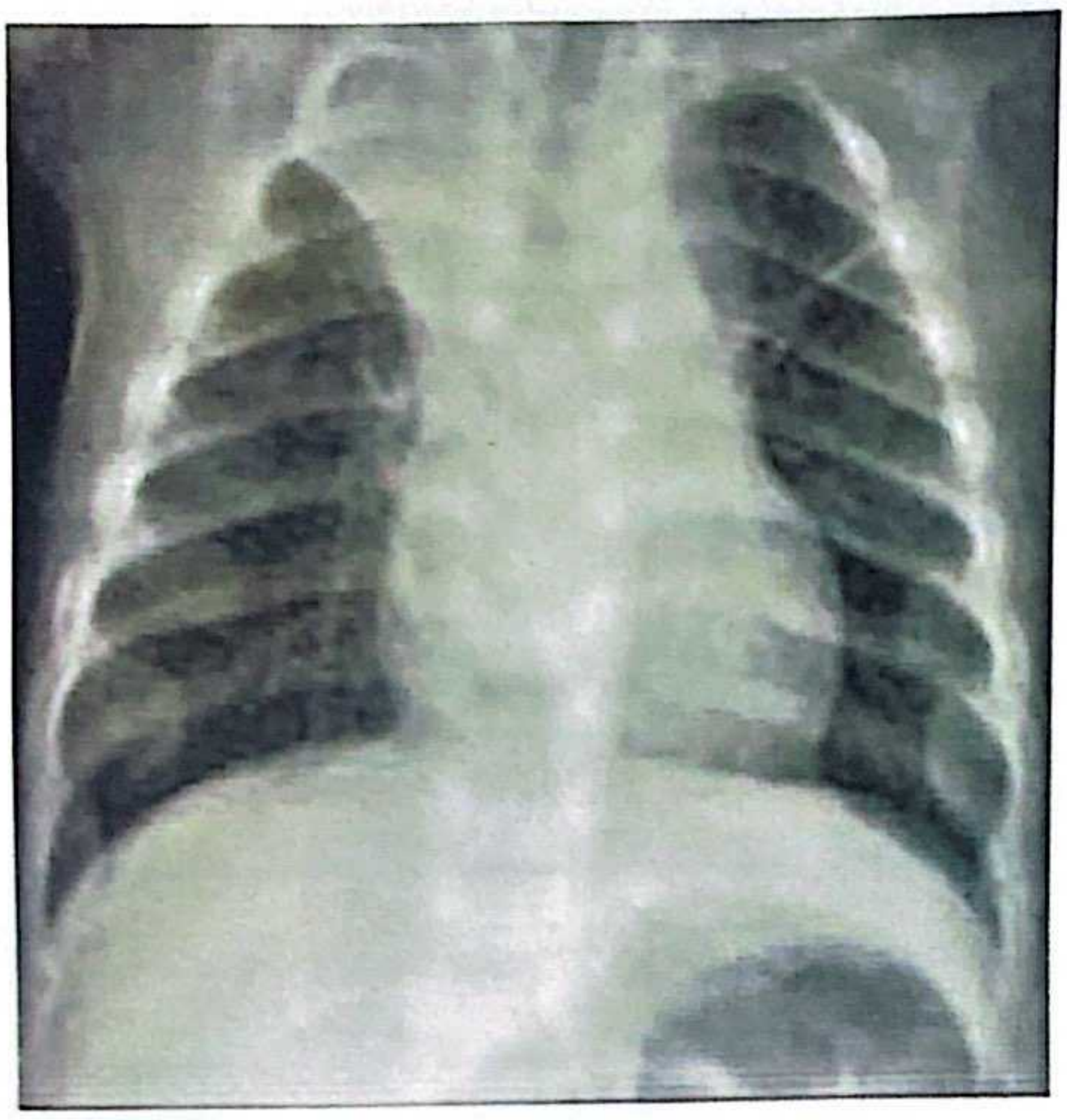
Identify: Plain X-Ray AP View Wrist Joint

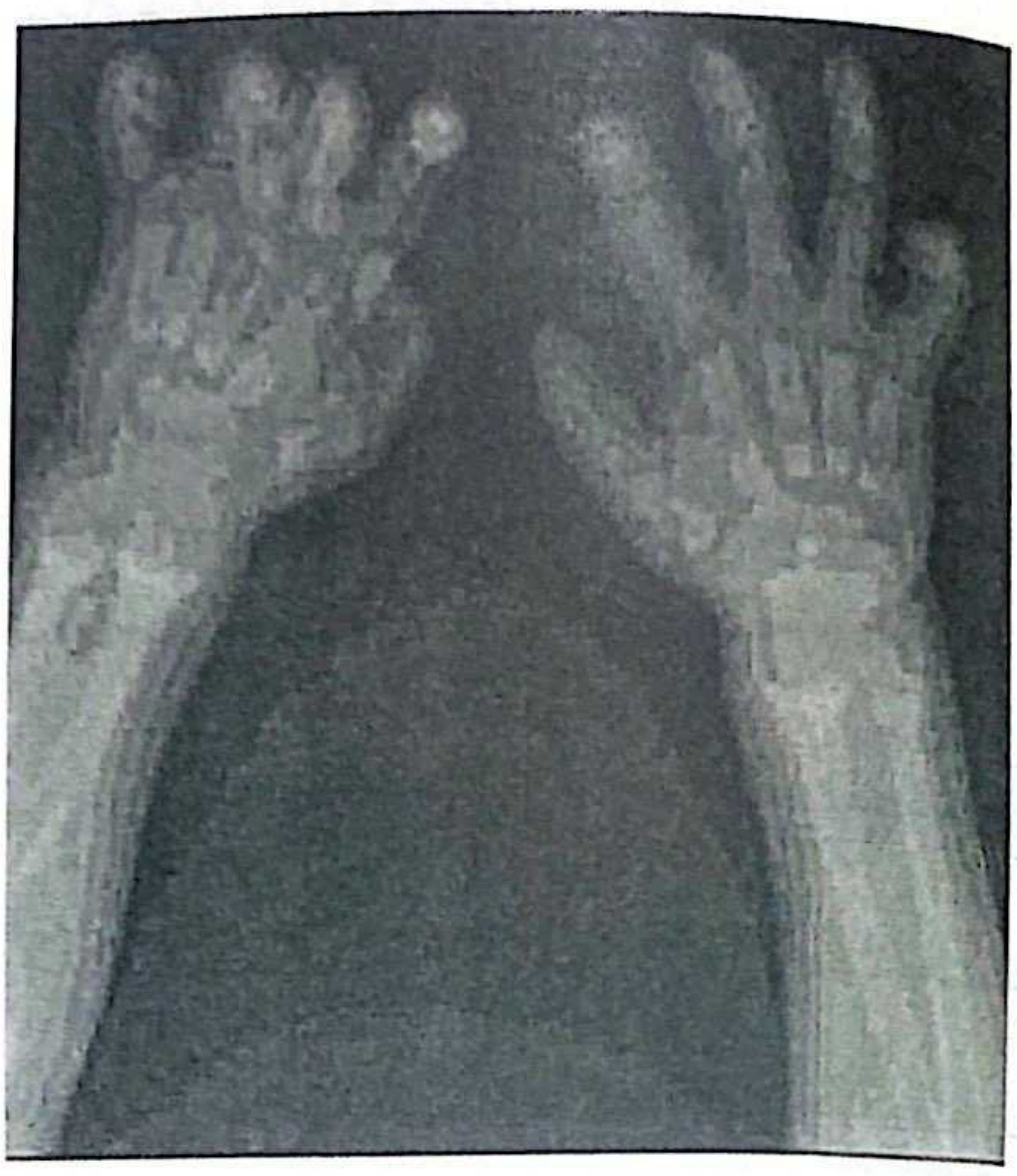
Describe: Irregularity, collapse, flattening, sclerosis and loss of height of the lunate bone. There is strong ulnar negative variance

Diagnosis: Kienbock disease-Osteonecrosis lunate

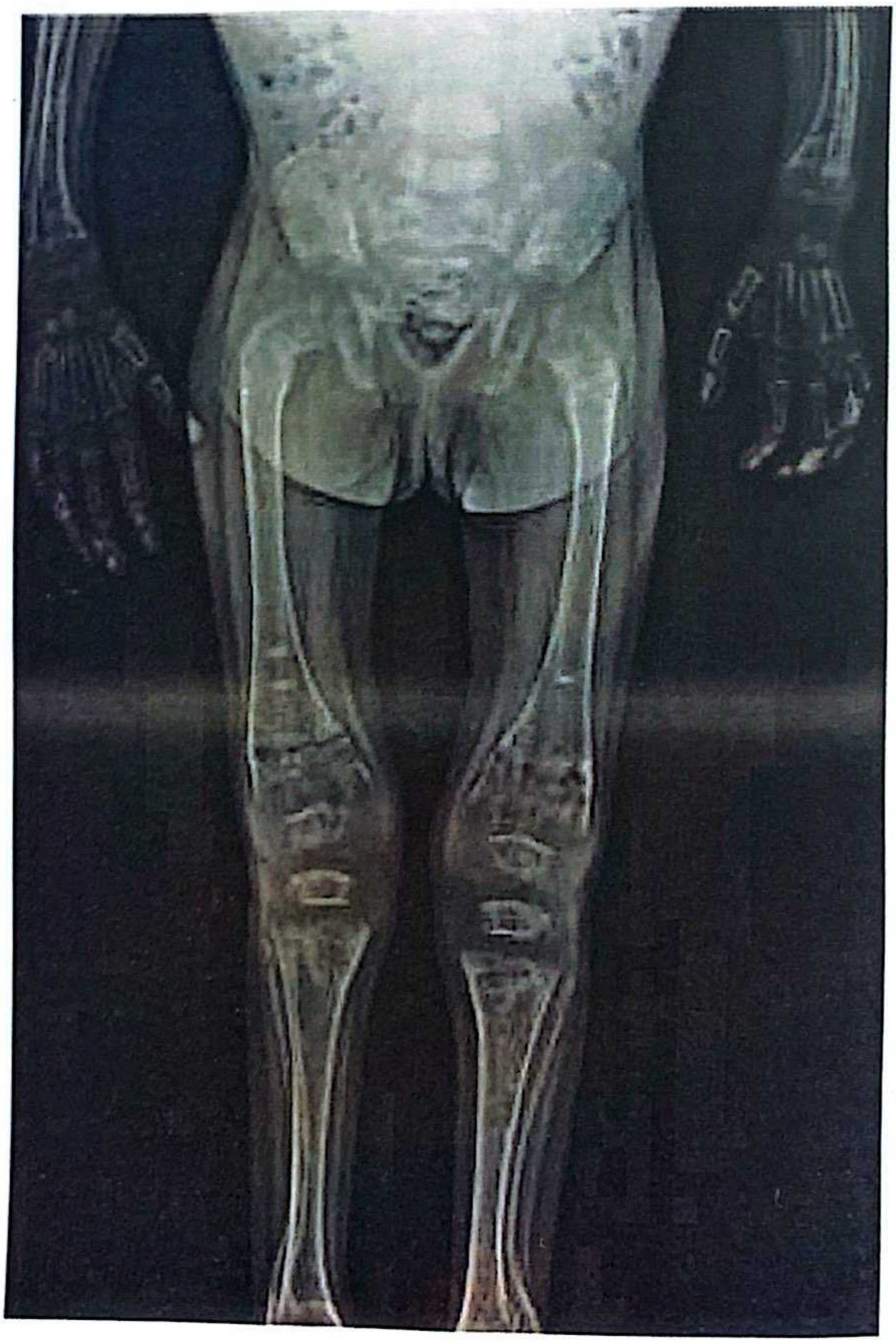
What next: Conservative management with rest, non-steroidal anti-inflammatory drugs and immobilisation in mild cases is often very effective

Q.24)





Both hands AP view demonstrating bilateral cupping and fraying of the metaphyseal regions of both bones with widening of the wrist joint space.

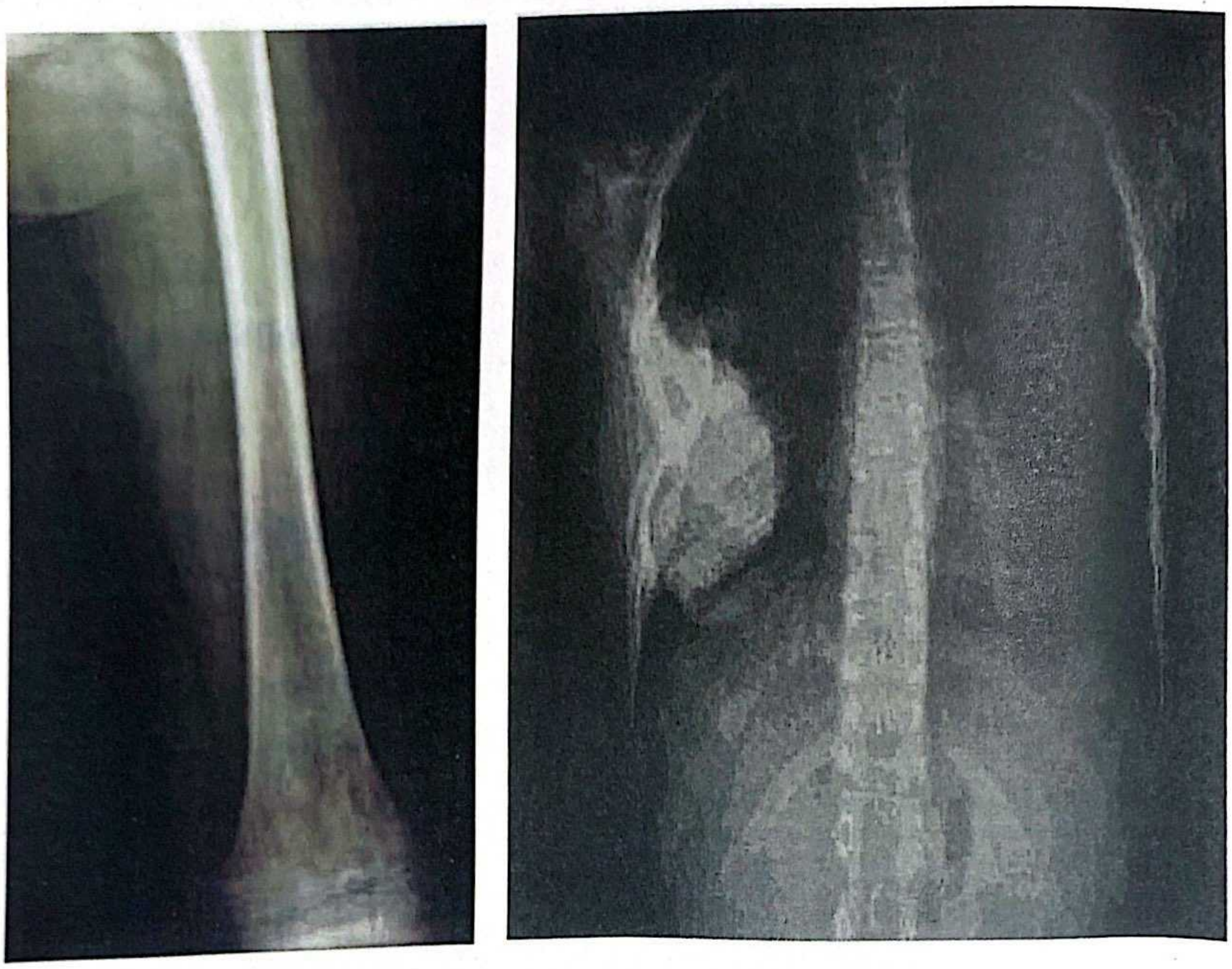


Extensive Osteoporosis, remodeling, cupping, fraying and bone age nearly less than 2 years.

This case depicts the classical imaging findings in active rickets.

- metaphyseal fraying and cupping in knee, shoulder, elbow and wrist joints
- widening of growth plate
- generalized osteoporosis
- delayed bone age
- widening of anterior end of ribs (rachitic rosary)
- coxa vara deformity

Q.25)



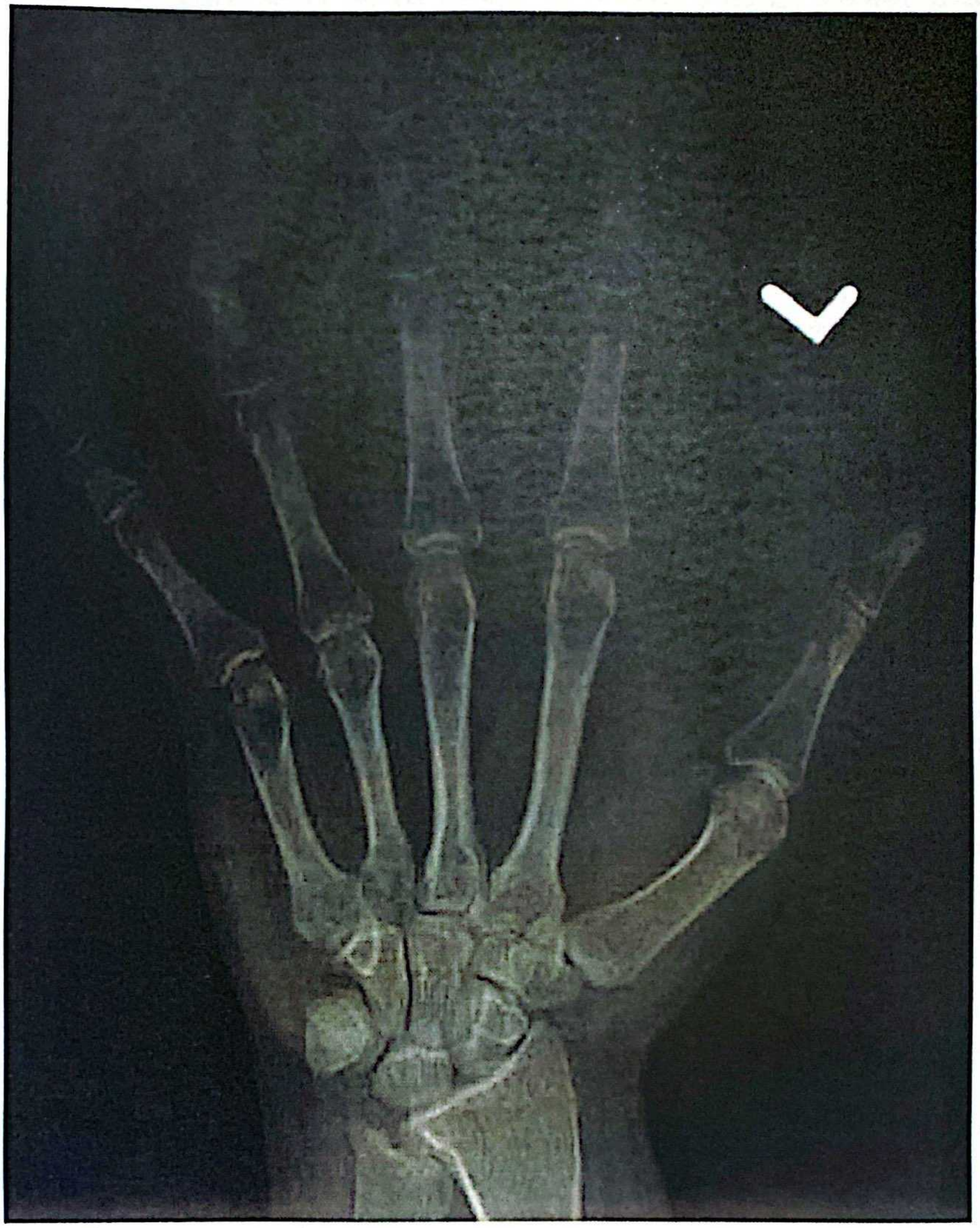
Right chest wall based mass with destruction of the right 6th rib. The mass has a significant soft tissue element.

Ill-defined lucency in the distal femur is noted, with a wide zone of transition and onion-skin periosteal reaction. Ewing sarcomas demonstrate increased uptake on both Gallium67-citrate and all three phases of the Technetium99m methylene diphosphonate bone scans

Differential is that of other tumours of the chest wall

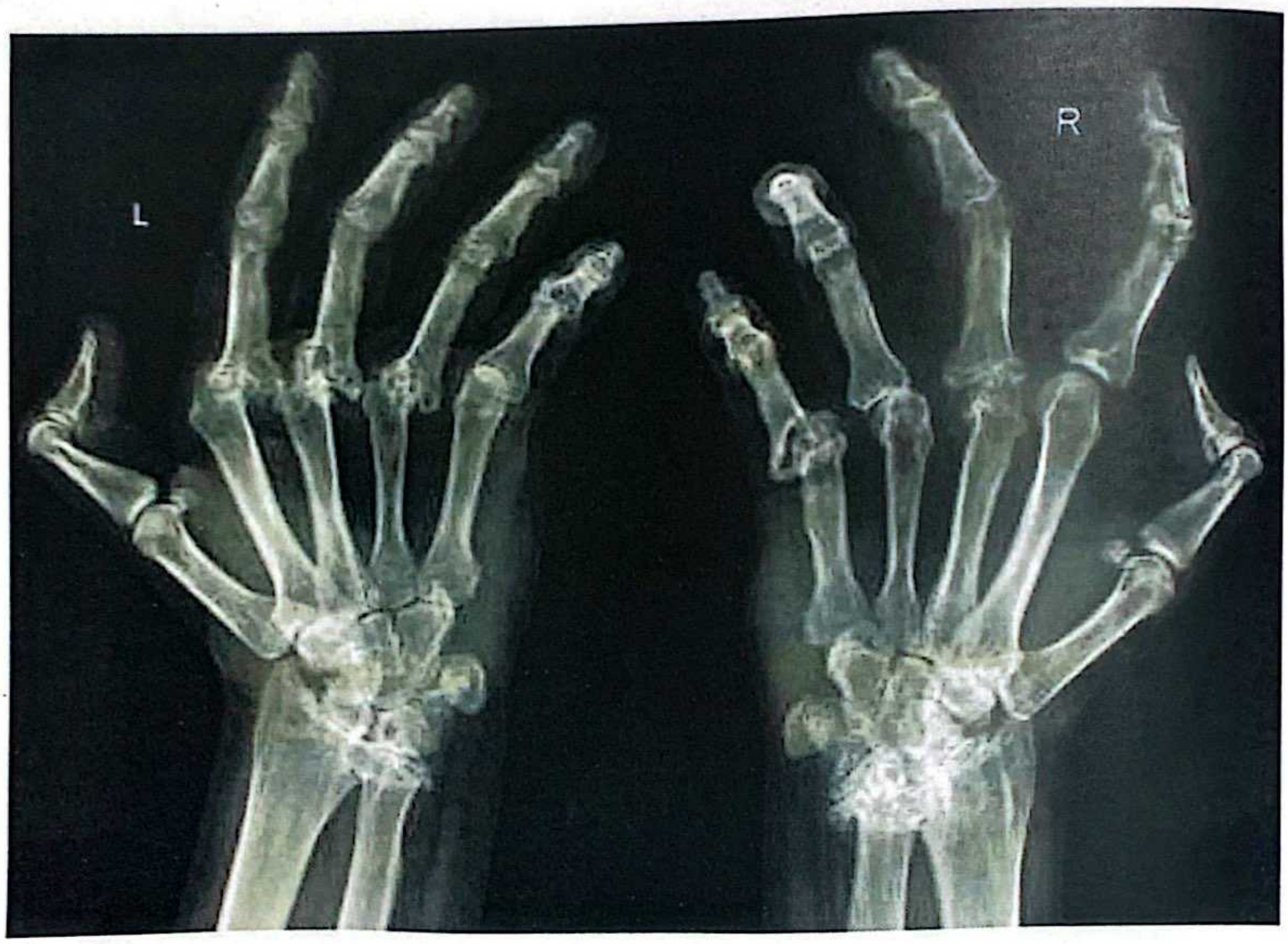
- Rhabdomyosarcoma
- Osteosarcoma
- Chest wall and pleural metastases
- Lymphoma

Q.26)



Xray of the hand of a girl with Turner's syndrome, demonstrating the characteristic findings of short fourth metacarpal with positive metacarpal sign. Also note the Madelung deformity.

Q.27)



Advanced features of rheumatoid arthritis, with erosive subluxation most marked of the MCP joints with ulnar deviation. Prominent degenerative change is also seen at the ulnar-carpal articulation. Note also osteopaenia particularly of the MCP regions.

Plain radiography

- Soft tissue swelling
- osteoporosis: initially juxta-articular, and later generalised; compounded by corticosteroid therapy and disuse
- joint space narrowing: symmetrical or concentric
- marginal erosions: due to erosion by pannus of the bony “bare areas”

Hands and wrists

- There is a predilection for:
- PIP and MCP joints (especially 2nd and 3rd MCP)
- ulnar styloid
- triquetrum
- As a rule, the DIP joints are spared.

Feet

- Like the hands, there is a predilection for the PIP and MTP joints (especially 4th and 5th MTP) involvement of subtalar joint

Hip

- concentric loss of joint space, compared with osteoarthritis (OA) where there is a tendency for superior loss of joint space
- acetabular protrusio

Knee

- Joint effusion
- Typically involves the lateral or non-weight bearing portion of the joint
- loss of joint space involving all three compartments
- lack of subchondral sclerosis and osteophytes, compared with OA
- prepatellar bursitis

CT

- CT is not routinely used in the evaluation of peripheral RA. It has applications in imaging of the spine, and peri-operative assessment.

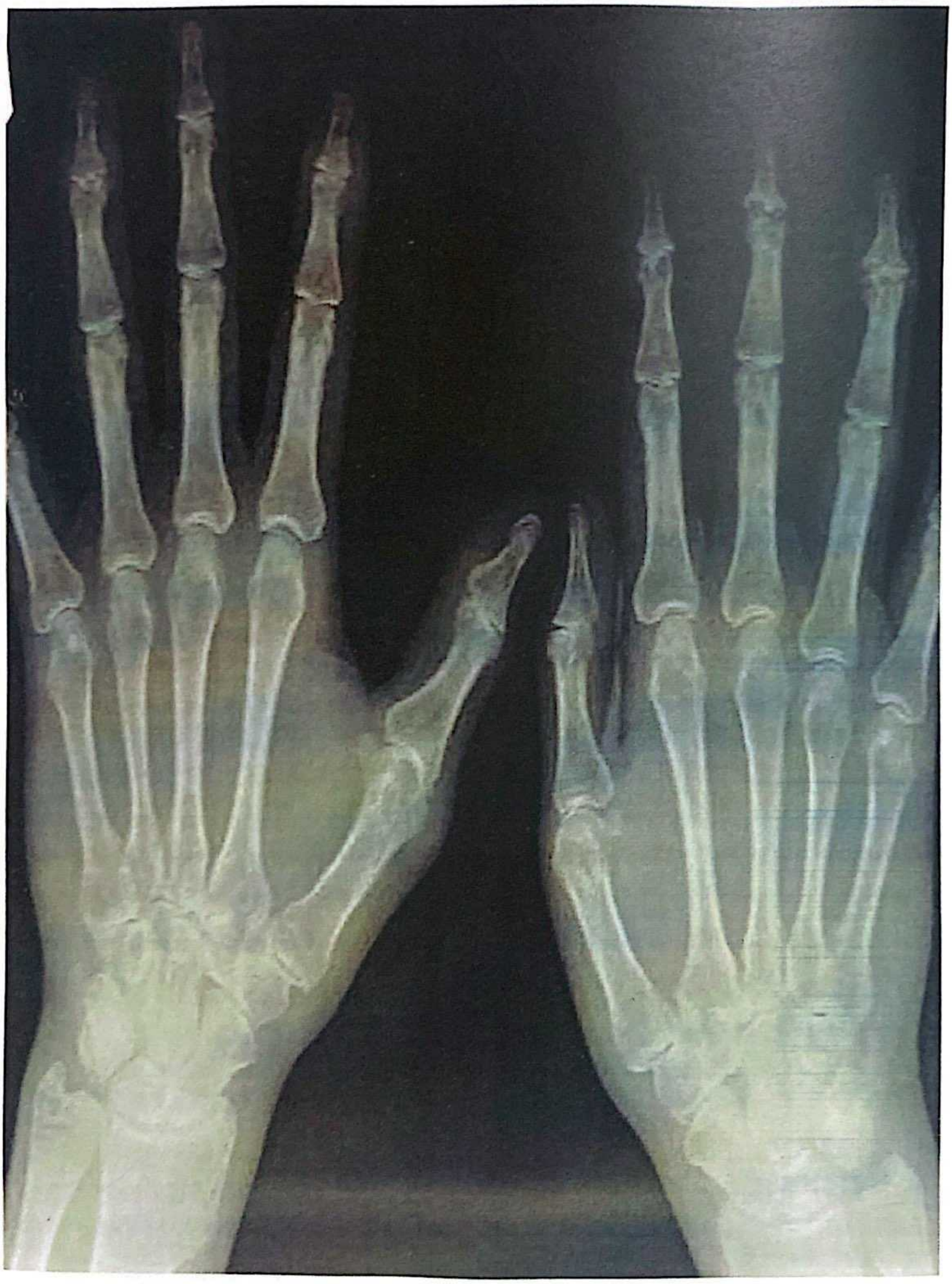
MRI

MRI is particularly sensitive to the early and subtle features of RA.

Differential Diagnosis:

- Osteoarthritis
- Erosive osteoarthritis
- Psoriatic arthritis (PsA)
- MRI dynamic enhancement pattern may differentiate PsA from RA at 15 minutes reactive arthritis (Reiter syndrome)

Q.28)



PSORIATIC ARTHRITIS

- This is usually HLA B27 positive and is associated with skin and nail changes in the majority of cases.

Hand+ foot

Target area: DIP, PIP, MCP

- **"sausage digit"** = soft-tissue swelling of entire digit
- Destruction of distal interphalangeal joints (erosive polyarthritis) +osseous resorption
- Bony ankylosis (10%)
- **"pencil-in-cup" deformity= erosions with ill-defined margins+ adjacent proliferation of periosteal new bone (CHARACTERISTIC)**
- **Ivory phalanx** = sclerosis of terminal phalanx (28%)
- **Destruction of interphalangeal joint of 1st toe with exuberant periosteal reaction + bony proliferation at distal phalangeal base (PATHOGNOMONIC).**
- Poorly defined diffuse new bone formation at attachment of Achilles tendon + plantar aponeurosis
- Erosions at superior I posterior margin of calcaneus (20%)
- Acroosteolysis (occasionally)

Axial skeleton

- **"floating" osteophyte** = large bulky vertically oriented paravertebral soft-tissue ossification (AP view)
- **Location: lower cervical**, thoracic, upper lumbar spine; asymmetric I unilateral
- **Squaring of vertebrae in lumbar region**
- **Sacroiliitis (40%) =(most commonly) bilateral +** symmetric sacroiliac joint widening, increased density, fusion
- Apophyseal joint narrowing + sclerosis
- Atlantoaxial subluxation +odontoid abnormalities

Differential diagnosis:

- Rheumatoid arthritis
- erosive osteoarthritis
- “gull wing” central erosions are present in erosive OA vs “mouse ears” peripheral bare area erosions in PsA
- Reactive arthritis (Reiter syndrome)

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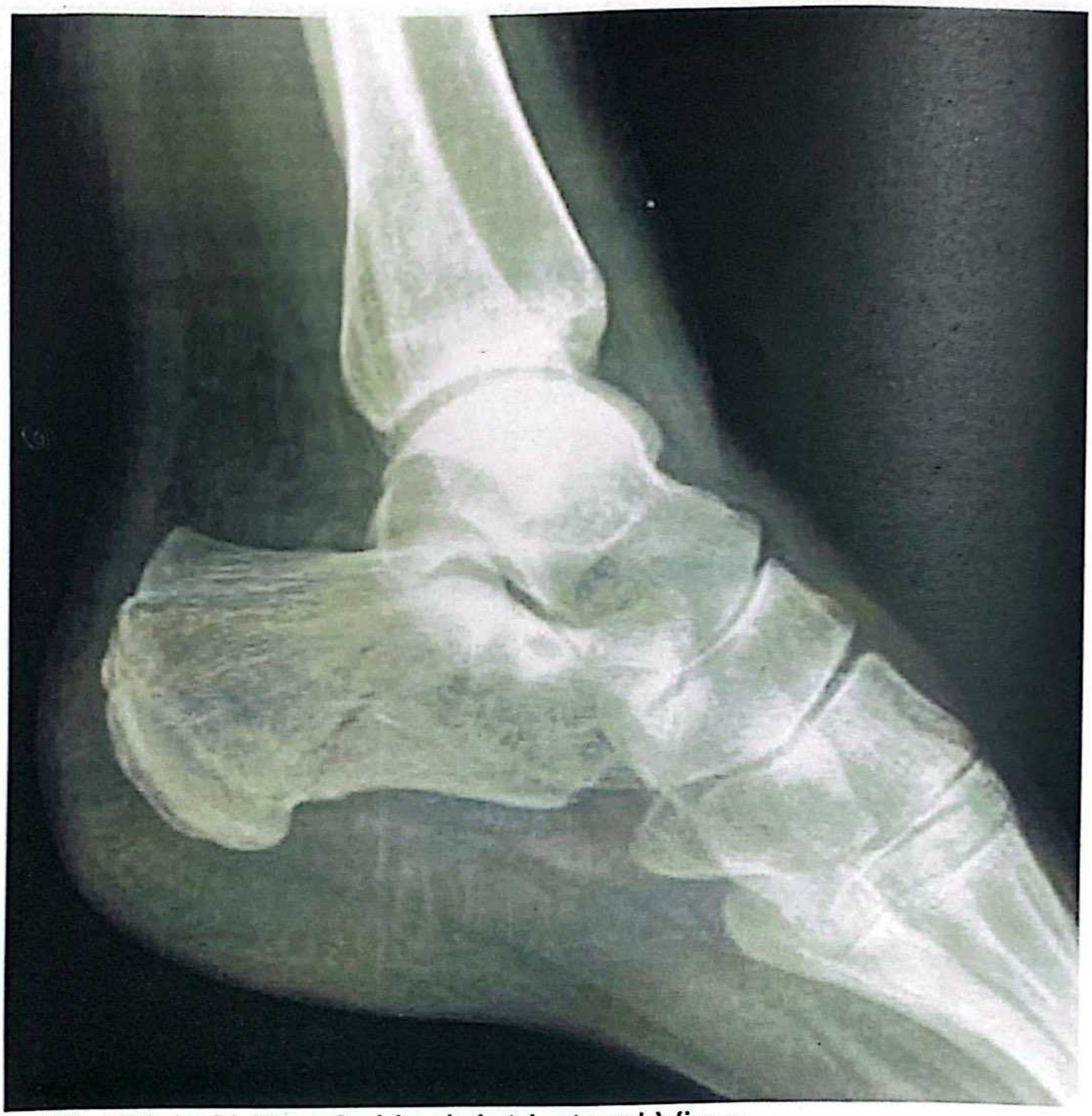
Q.29) **(2017)**



Identify: Plain X-Ray Ankle Joint Lateral View

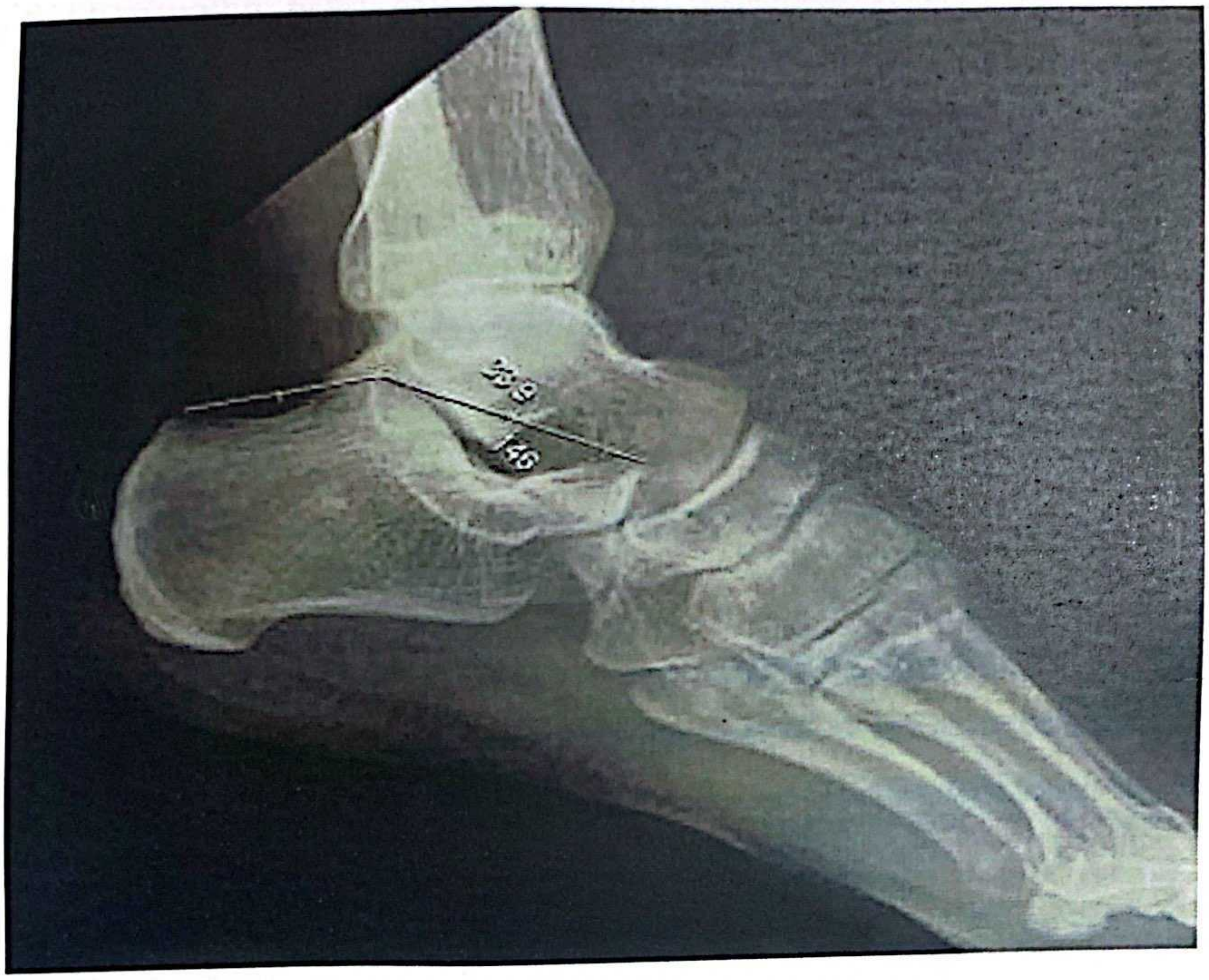
Describe: Calcaneal fracture with a decreased Bohler angle to less than 20 degrees.

What next:

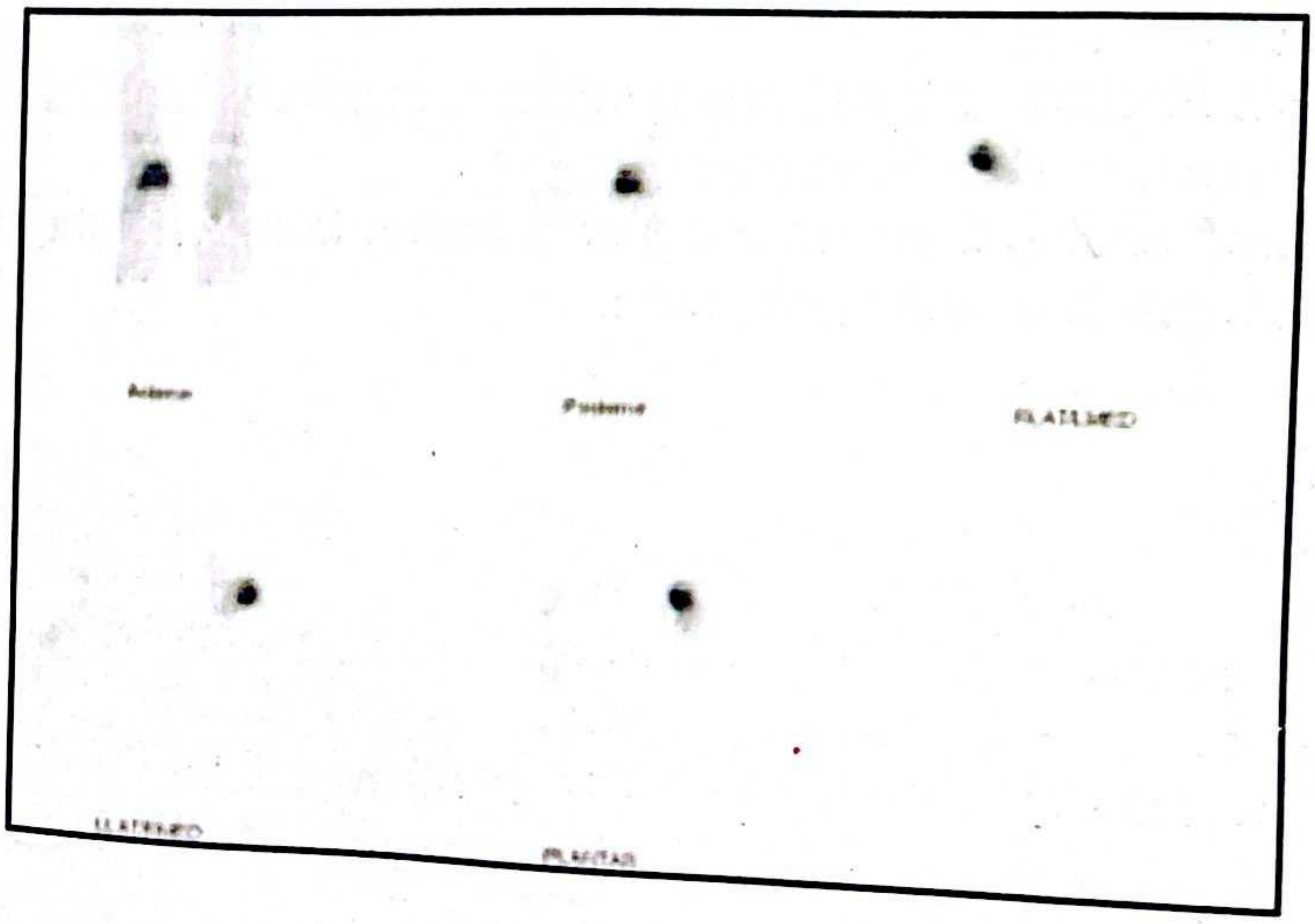
CT

CT is the modality of choice to evaluate calcaneal fracture. It can show the extent and extra- or intra-articular components of the fracture and haematoma along sole of foot (Mondor sign). Intra-articular fractures are often classified using the Sander classification system, which is one of the only systems that correlate well with patient outcome.

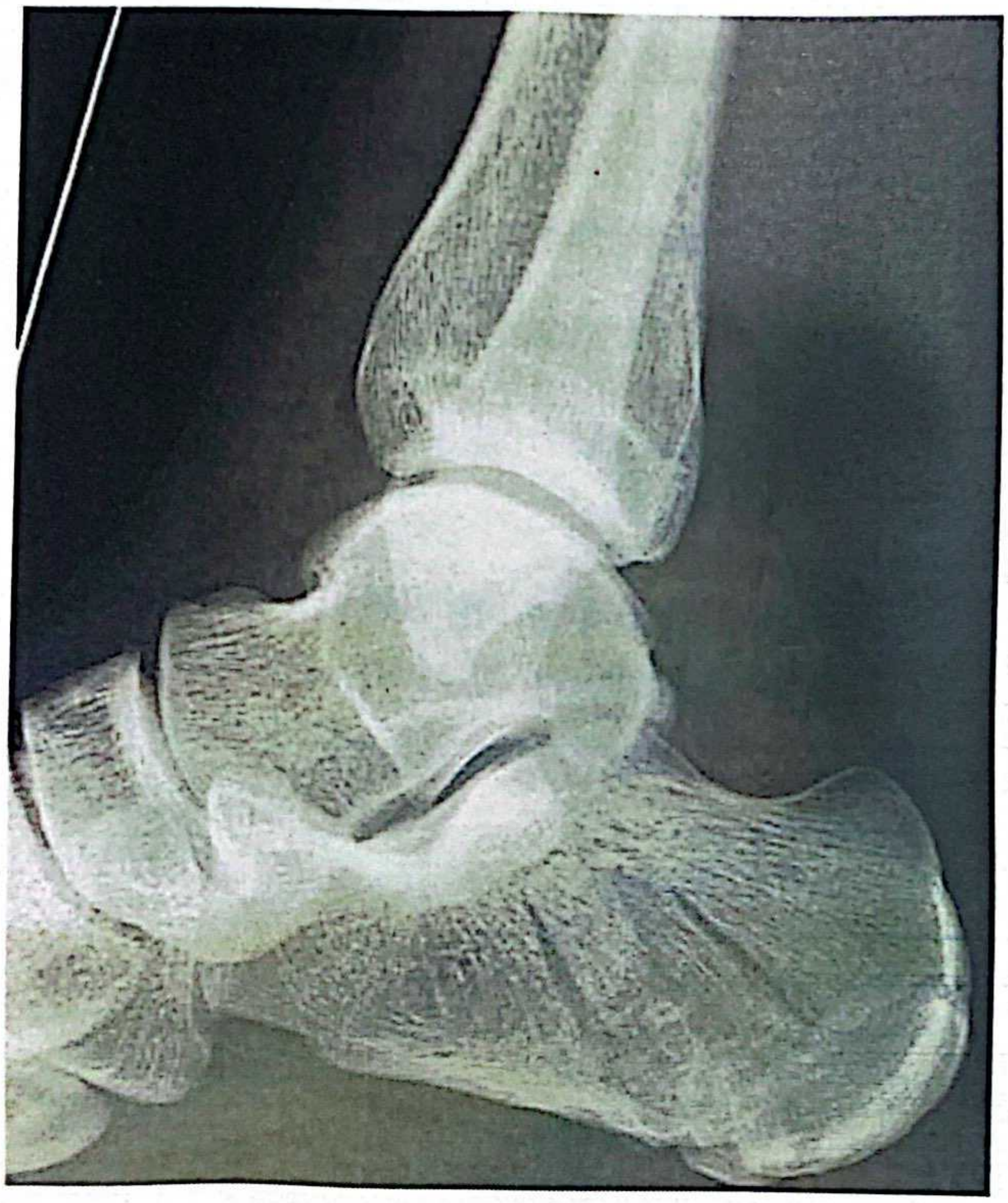
If bilateral calcaneal fractures are seen, then the spine should also be evaluated for fracture as the mechanism of injury is often a large load to the axial skeleton, such as jumping from a second story window.



Böhler's angle is the angle between two tangent lines drawn across the anterior and posterior borders of calcaneus in the lateral view. When Böhler's angle becomes <20°, it indicates a calcaneal fracture. On a lateral radiograph, an angle of Gissane of >130° suggests depression of the posterior facet of the subtalar joint.



Delayed static images show an intense increase in tracer uptake localised to the posterior aspect of the right calcaneum highly suspicious of a stress fracture.

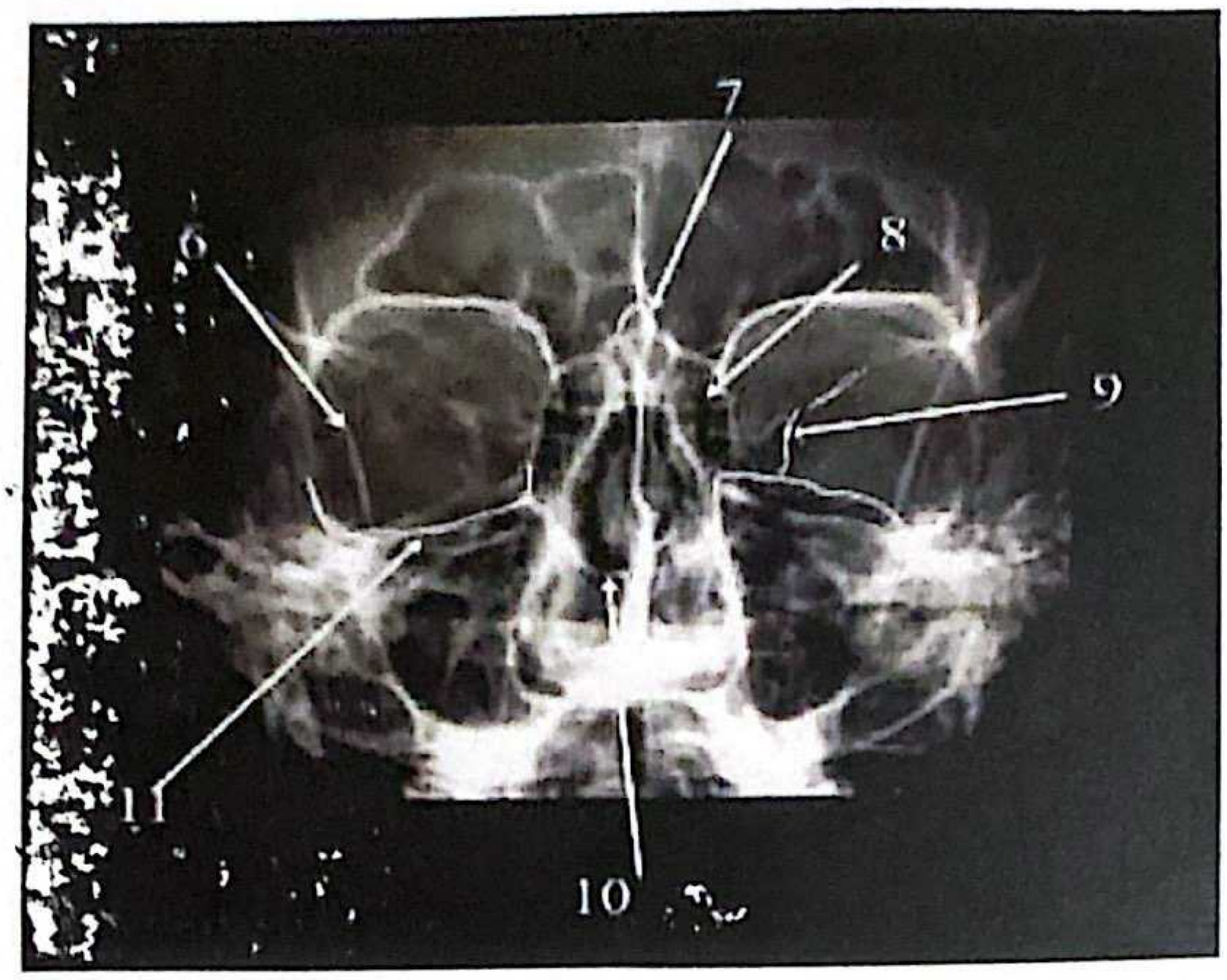


Undisplaced comminuted calcaneal fracture. Reduction in Bohler's angle. Soft tissue swelling over the lateral aspect of the ankle and hind foot.

A 'lover's fracture' is a calcaneal fracture, in which Bohler's angle is reduced to less than 20 degrees.

The name arising from the escapee jumping from a height to avoid being caught in an act of adultery

Q.1) (2013)

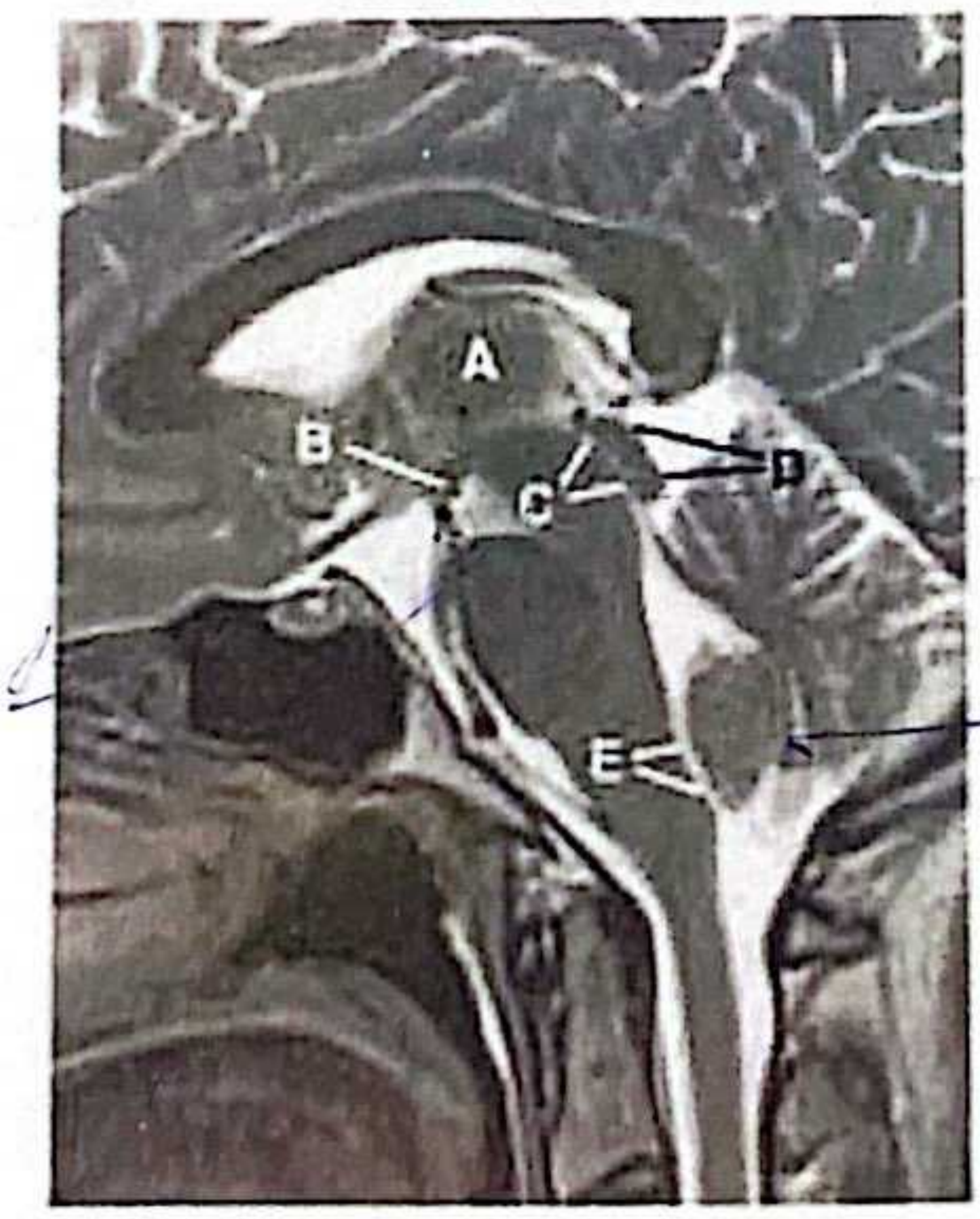


Answer.

AP Radiograph facial bones

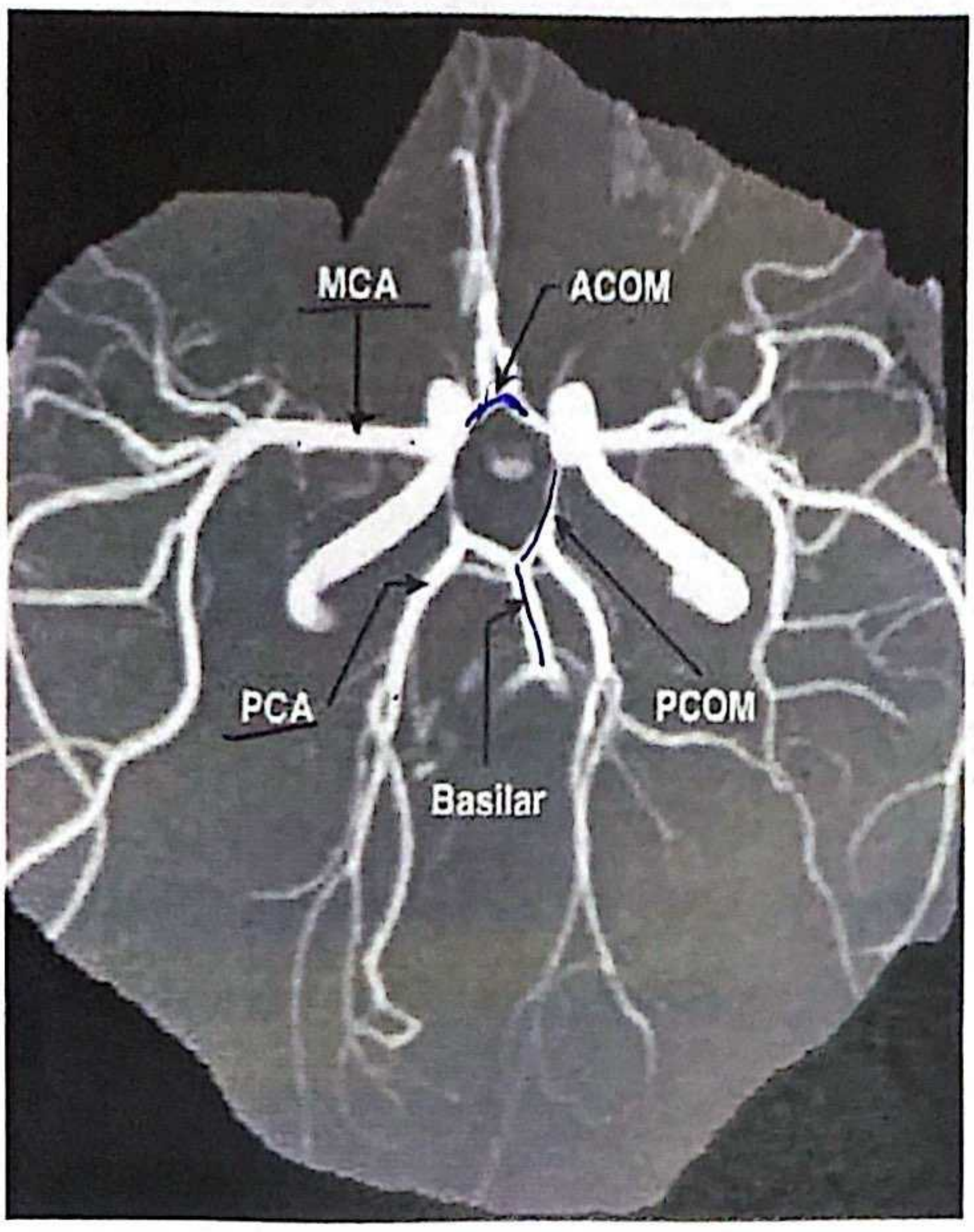
6: Greater Sphenoid Wing
7: Crista galli
8-9: Superior orbital fissure
10: Floor of sphenoid sinus
11: Floor of orbit

Q.2) (2015)

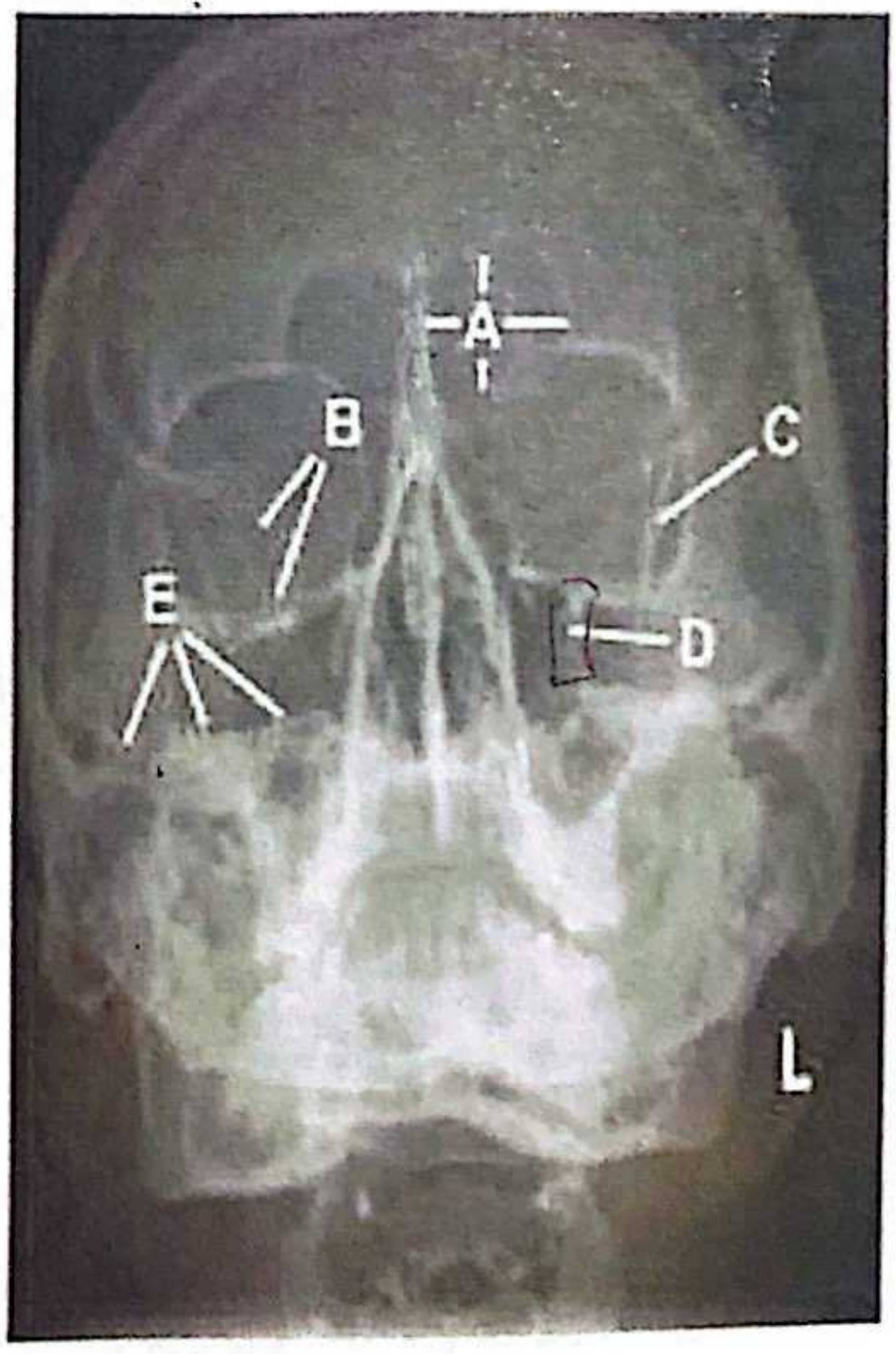


a Massa intermedia of thalamus
b Mamillary body
c Cerebral aqueduct (of Sylvius) allows CSF to flow from 3rd to 4th ventricles
d Superior and inferior colliculi
e Median aperture (of Magendie)

Q.3) LABELLING CIRCLE OF WILLIS (2017), (2018)


MCA
ACOM
PCA
PCOM
Basilar

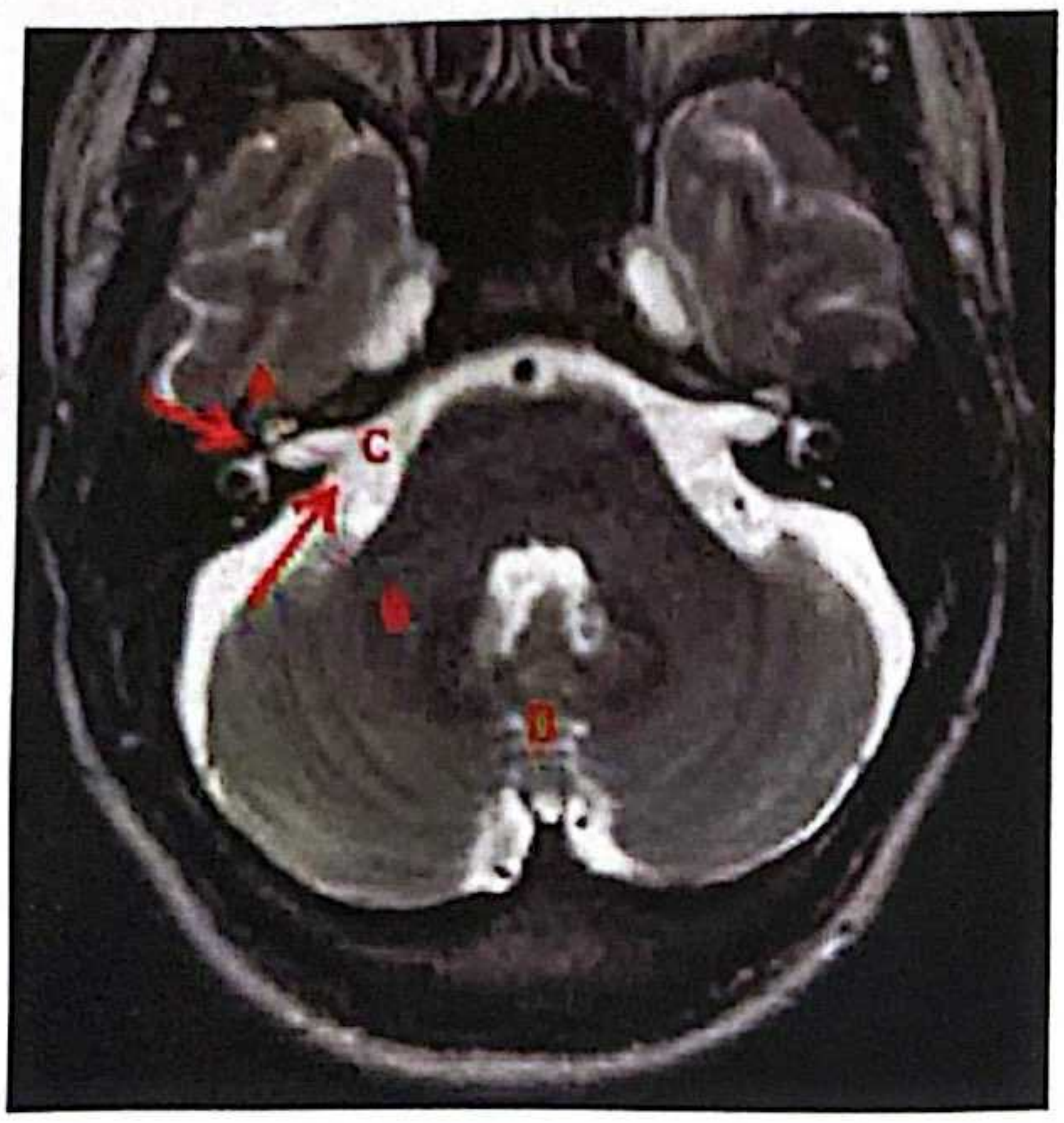
Q.4) Occipito-frontal facial radiograph (2017)



V2 tendon

a Frontal sinus
b Superior orbital fissure
c Innominate line
d Foramen rotundum
e Petrous ridge

Q.5)

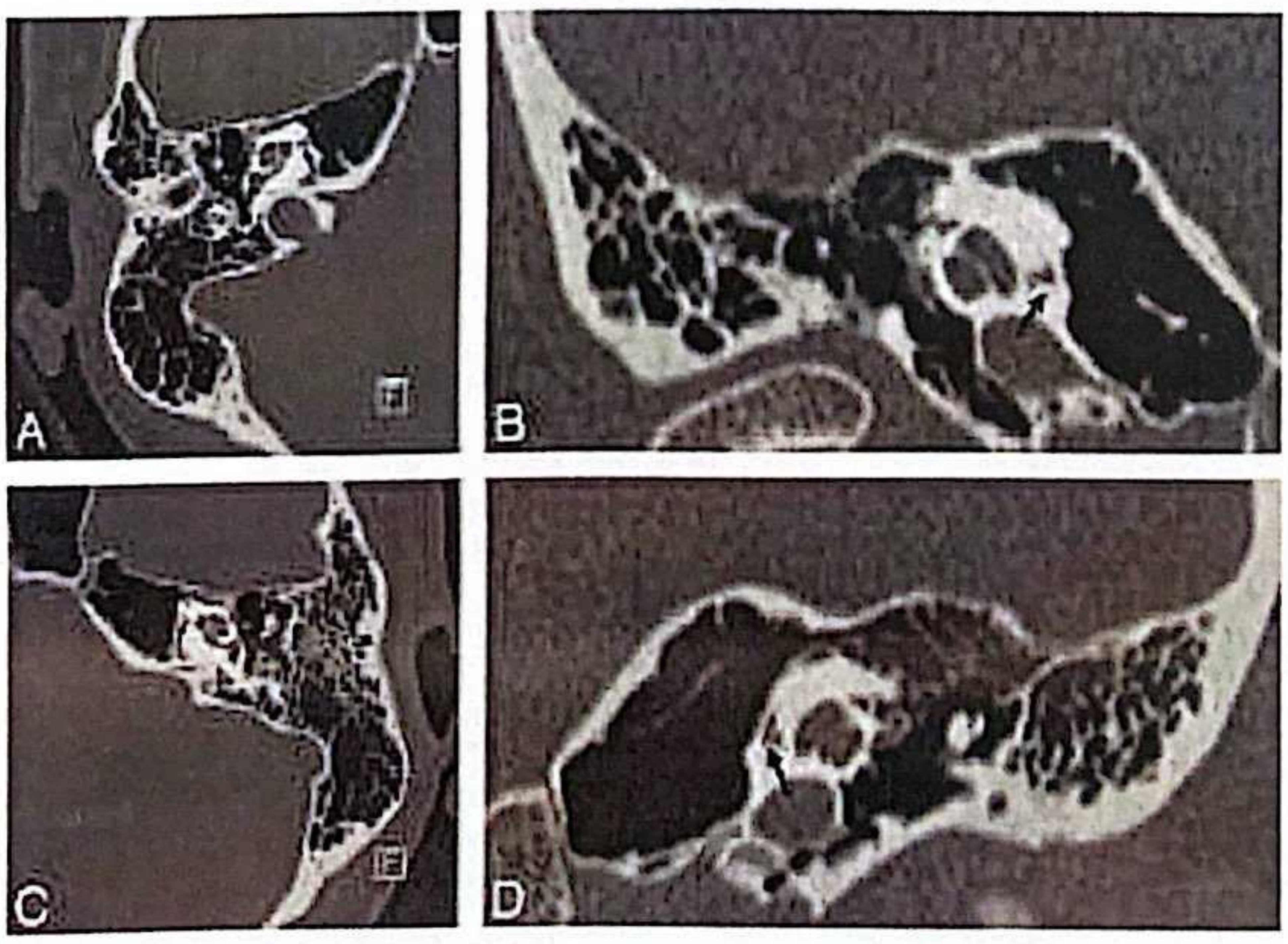


(2016)

Axial non-enhanced T2W image of brain at level of posterior fossa

A. COCHLEA
B. INTERNAL AUDITORY MEATUS
C. MIDDLE CEREBELLAR PEDUNCLE
D. VERMIS

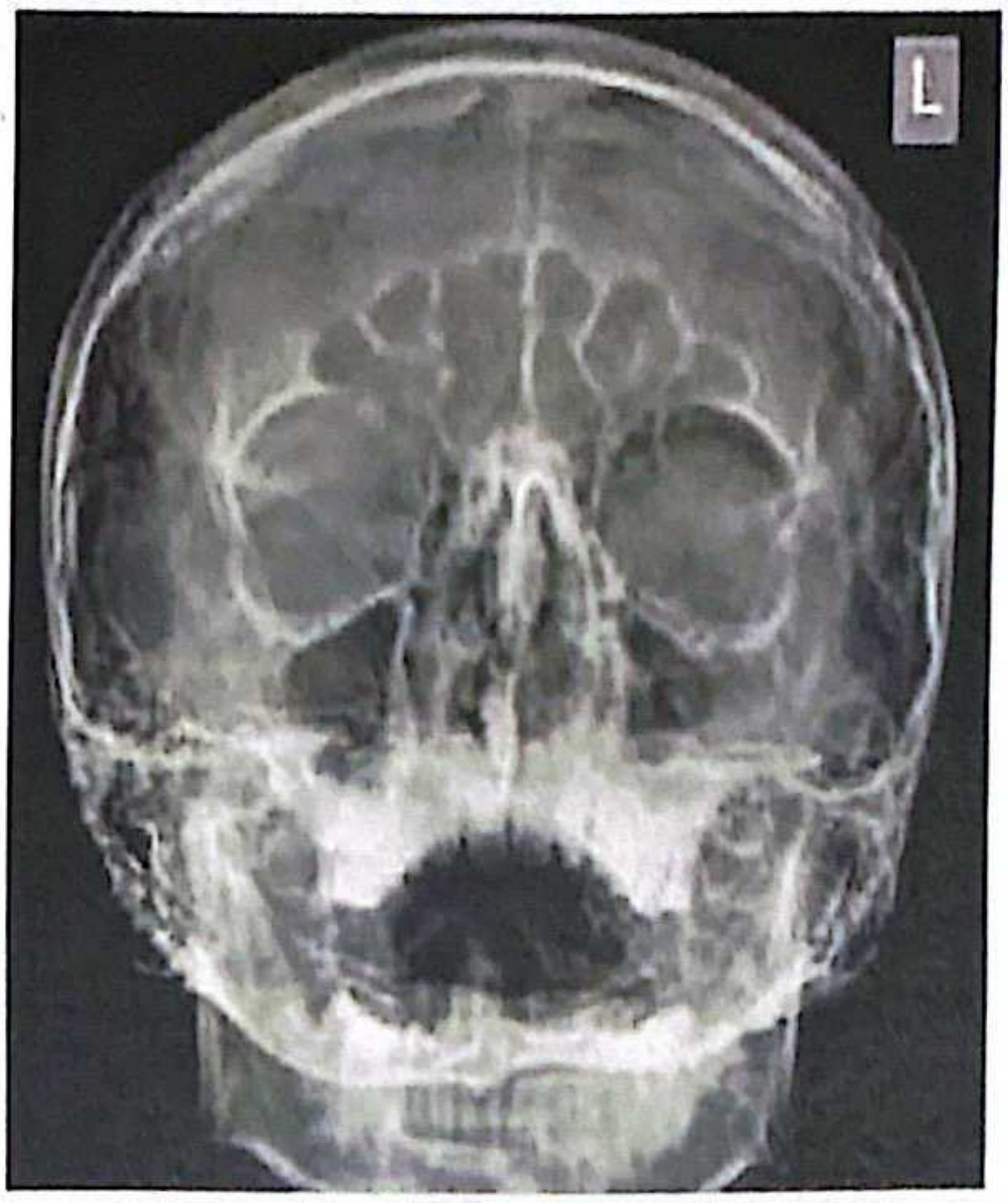
Q.6)



(2014)

1A: CT right petrous bone, bone window, two axial images and two coronal reformates.
Identify the following:
IAC
Cochlea
Facial nerve canal
Mastoid air cells

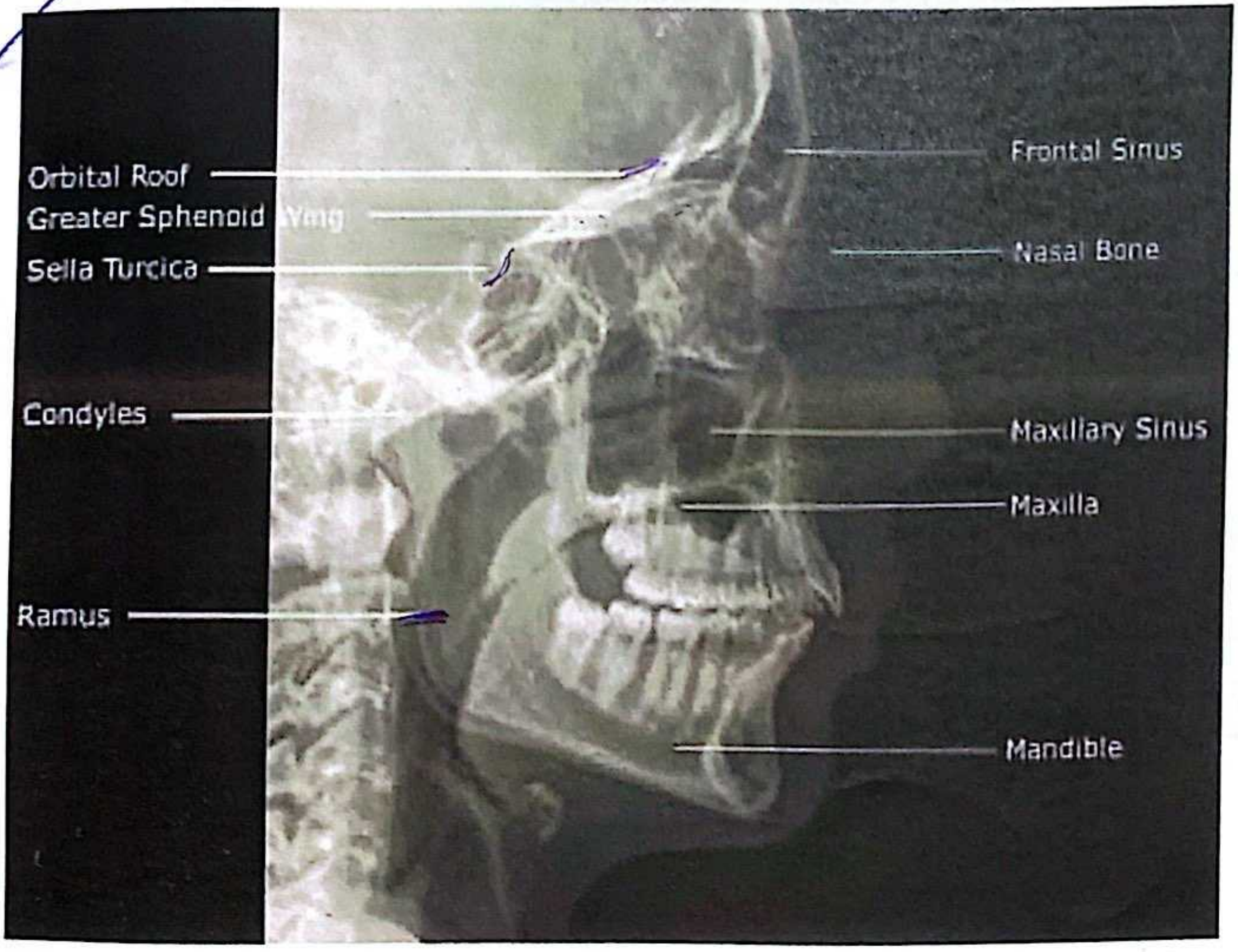
Q.7) **(2014)**

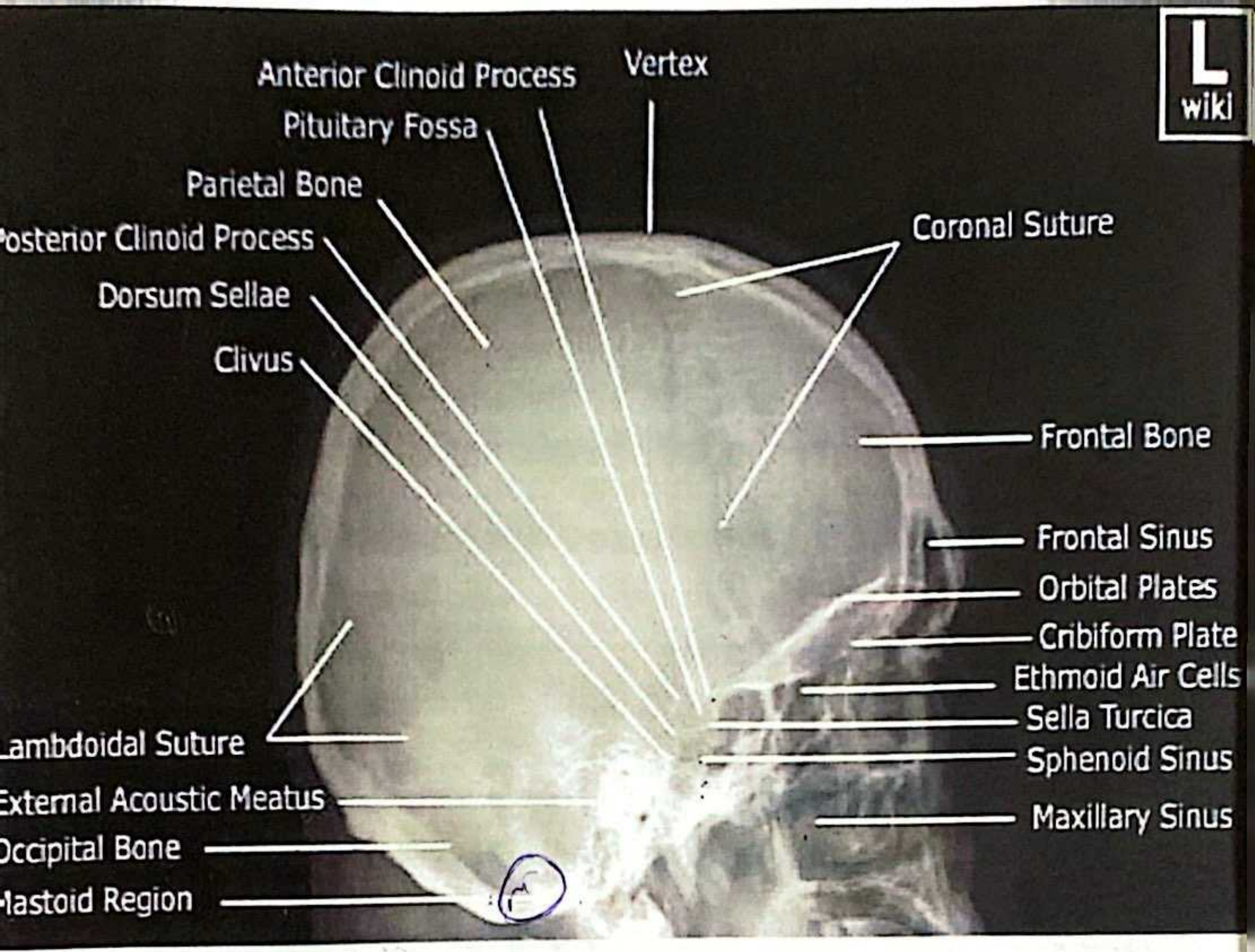


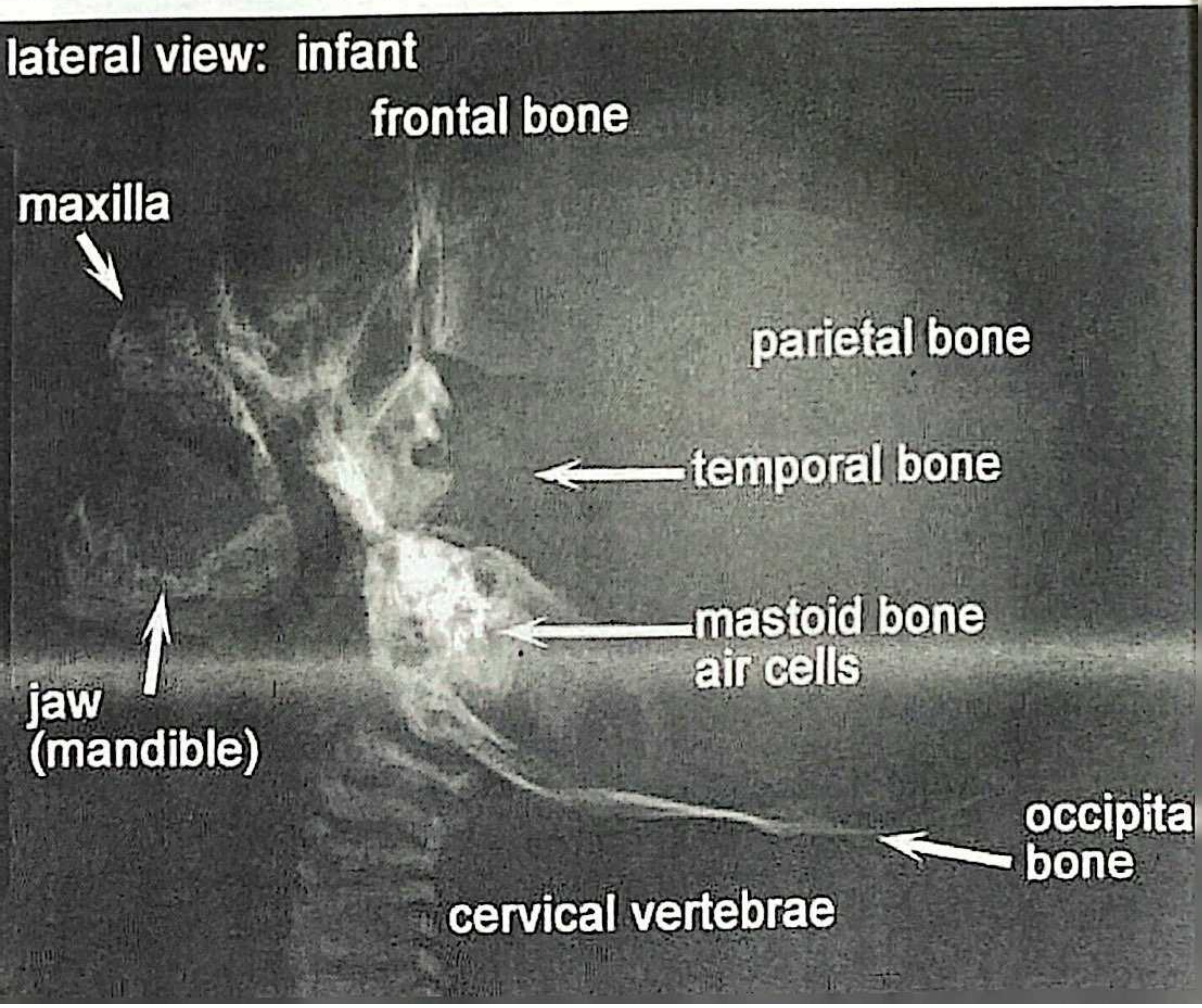
Radiograph skull, occipito-mental view with open mouth(Water's view):
Right superior orbital marign
Left maxillary sinus
Right zygomatic arch
Sphenoid sinus

M S M
2 Z

Q.8) **(2018)**


Orbital Roof
Greater Sphenoid Wing
Sella Turcica
Condyles
Ramus
Frontal Sinus
Nasal Bone
Maxillary Sinus
Maxilla
Mandible

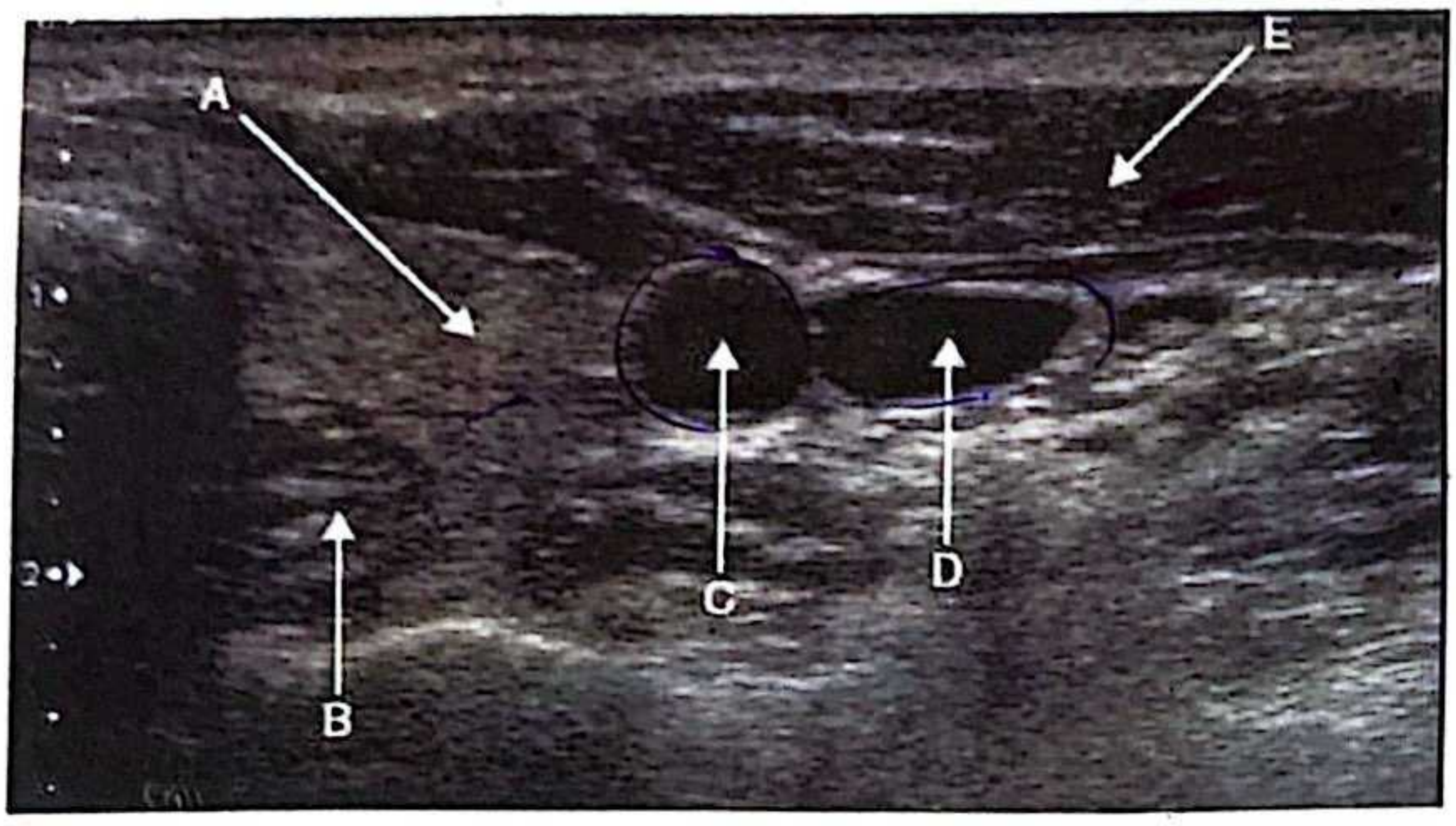

L
wiki
Anterior Clinoid Process
Vertex
Pituitary Fossa
Parietal Bone
Coronal Suture
osterior Clinoid Process
Dorsum Sellae
Clivus
Frontal Bone
Frontal Sinus
Orbital Plates
Cribiform Plate
Ethmoid Air Cells
Lambdoidal Suture
Sella Turcica
Sphenoid Sinus
xternal Acoustic Meatus
Maxillary Sinus
ccipital Bone
lastoid Region


lateral view: infant

frontal bone
maxilla
parietal bone
temporal bone
mastoid bone
air cells
jaw
(mandible)
occipita
bone
cervical vertebrae

NECK

Q.1) **(2017)**



Transverse ultrasound of the thyroid gland

(a) Left lobe of the thyroid gland. Each lobe measures approximately 4 cm in height, and extends from the thyroid cartilage of the trachea (superiorly), to the sixth tracheal ring (inferiorly). The recurrent laryngeal nerve runs posterior to this. This can be identified on ultrasound as a linear hypoechoic structure between the thyroid anteriorly and the ~~longus collis muscle pos~~teriorly.

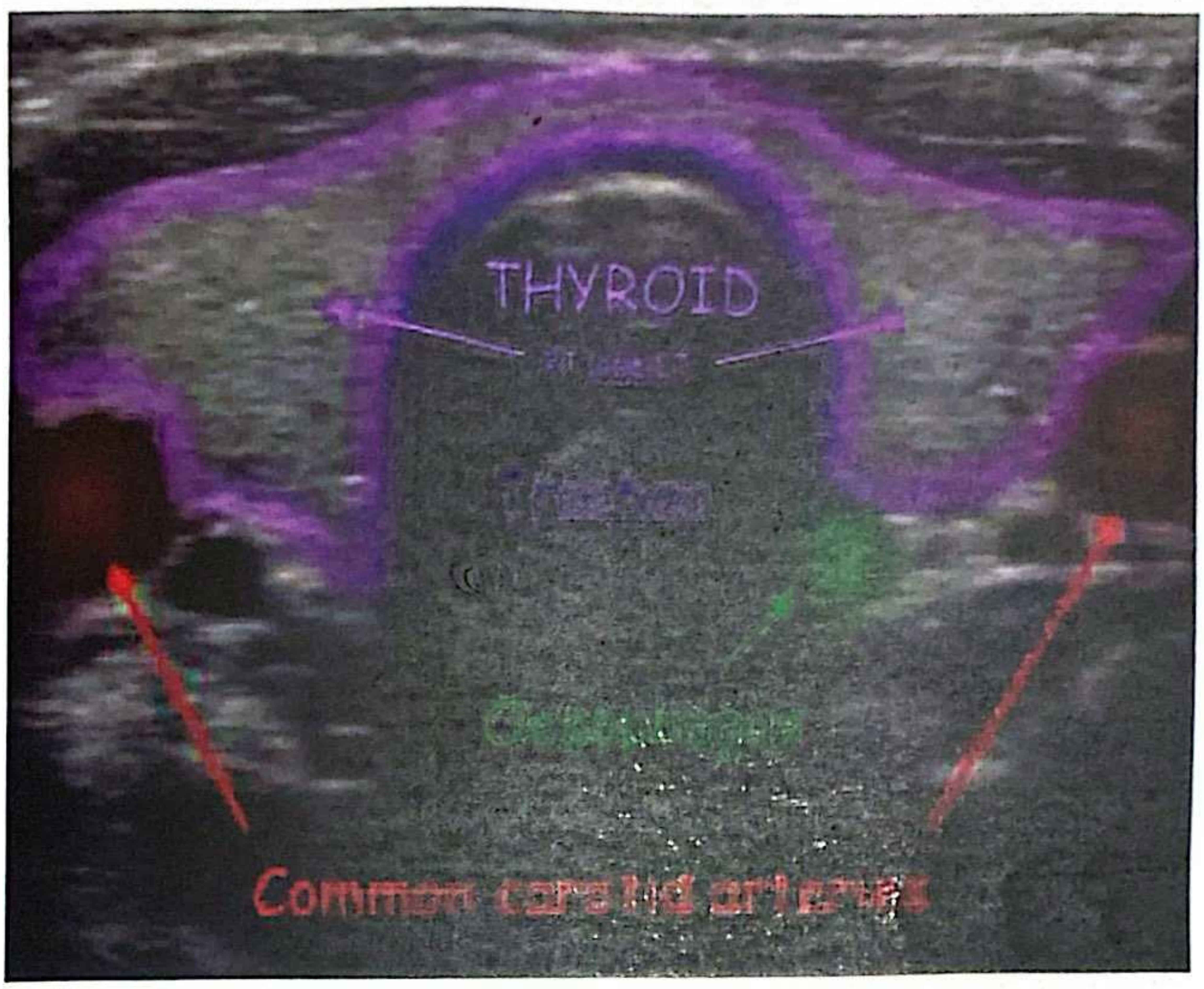
(b) Cervical oesophagus. This lies slightly to the left of the trachea and can be confused as a mass. It is readily identified by the central echobright area representing the air and saliva in the lumen. The surrounding hypoechoic rim is muscle.

(c) Left common carotid artery. This divides into external and internal branches at the upper border of the thyroid cartilage, at approximately C4 level. The vagus nerve (cranial nerve X) runs in the carotid sheath in the infrahyoid part of the neck.

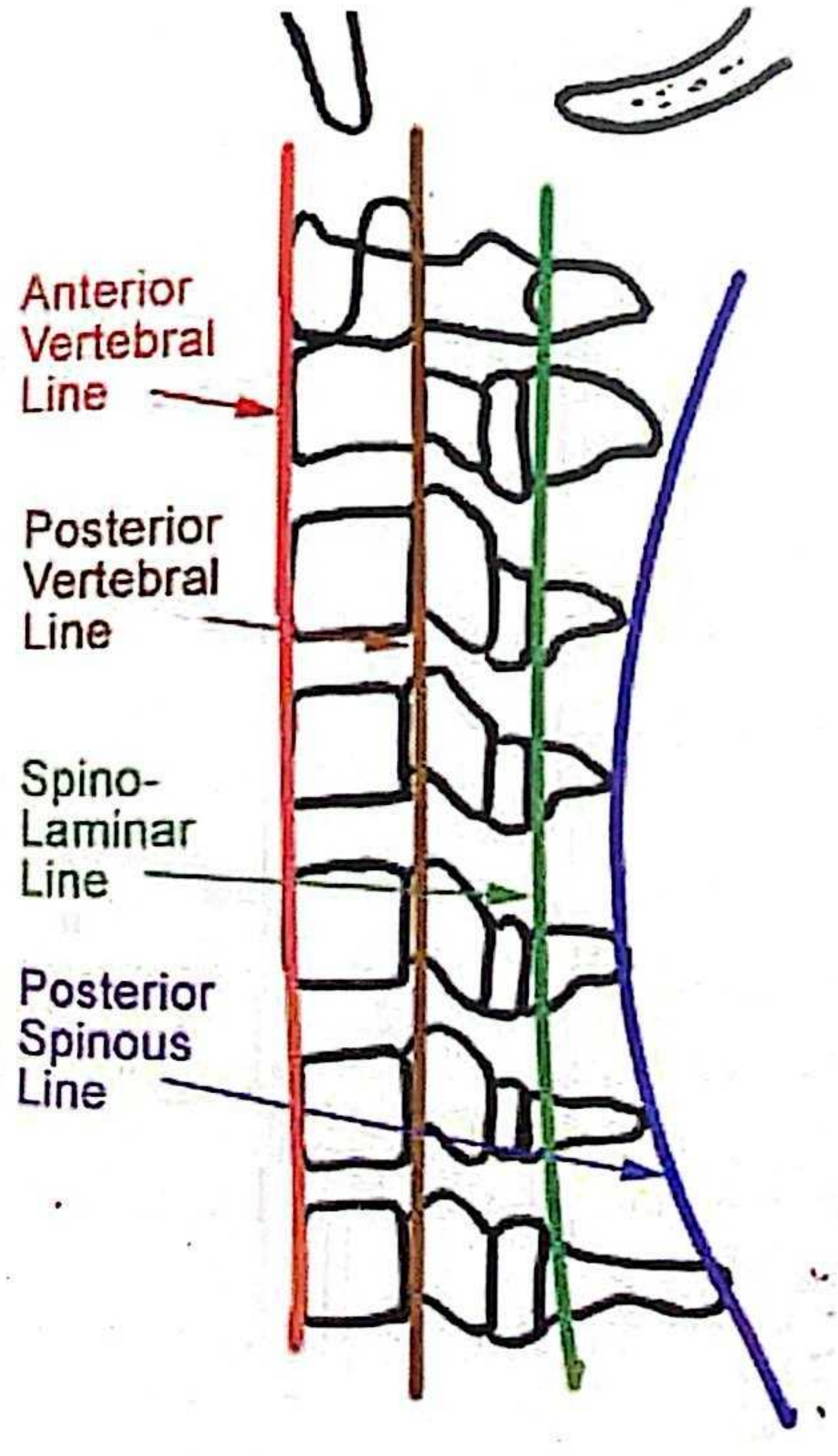
(d) Left internal jugular vein. This originates as a continuation of the sigmoid sinus and continues in the carotid sheath as it descends down the neck.

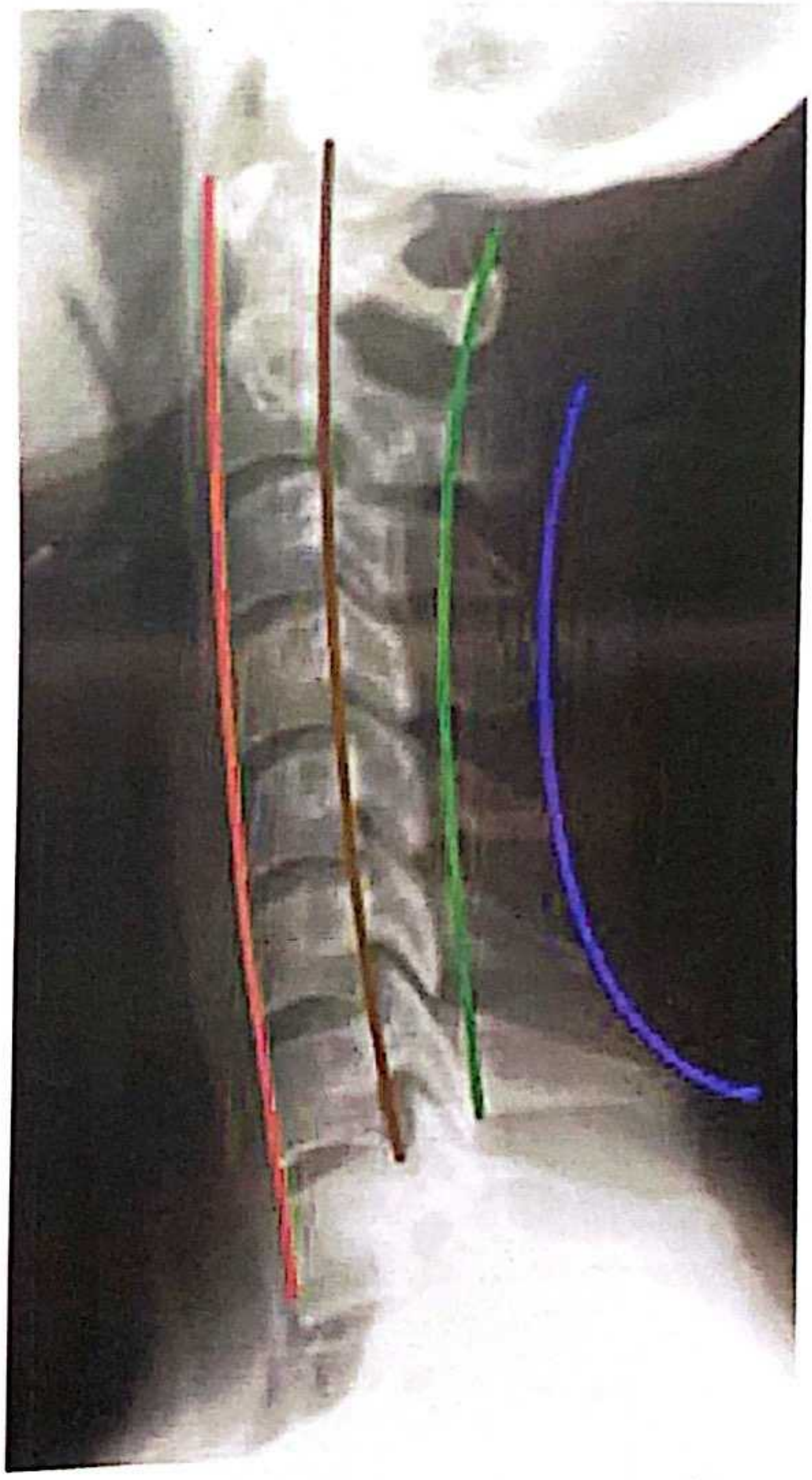
(e) Left sternocleidomastoid muscle. The muscle is a powerful rotator of the neck. Birth trauma may be associated with muscle damage, leading to contraction of the muscle causing congenital torticollis.

Q.2) **(2015)**


THYROID
Trachea
Oesophagus
Common carotid arteries

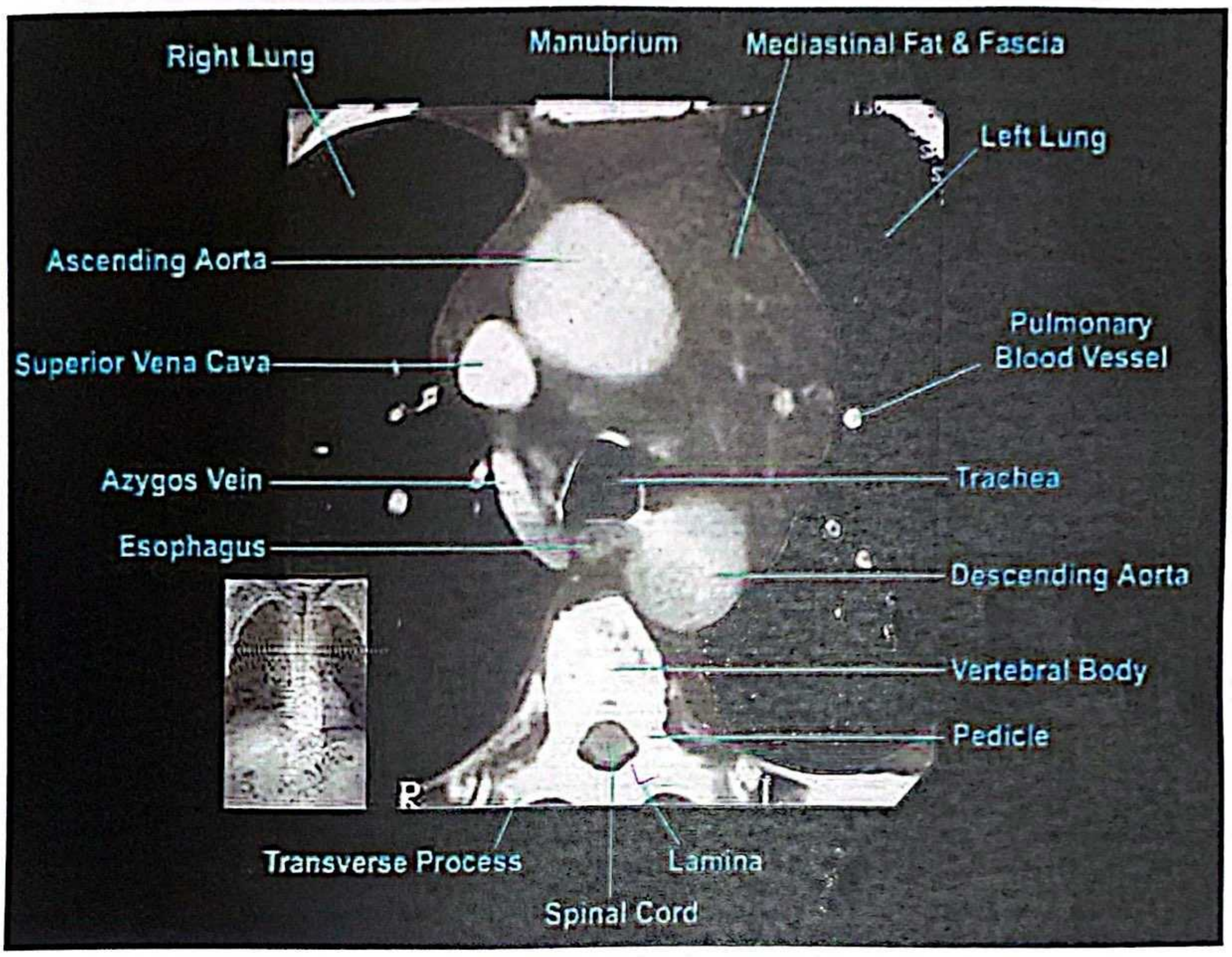
Q.3) **(2018)**


Anterior Vertebral Line
Posterior Vertebral Line
Spino-Laminar Line
Posterior Spinous Line

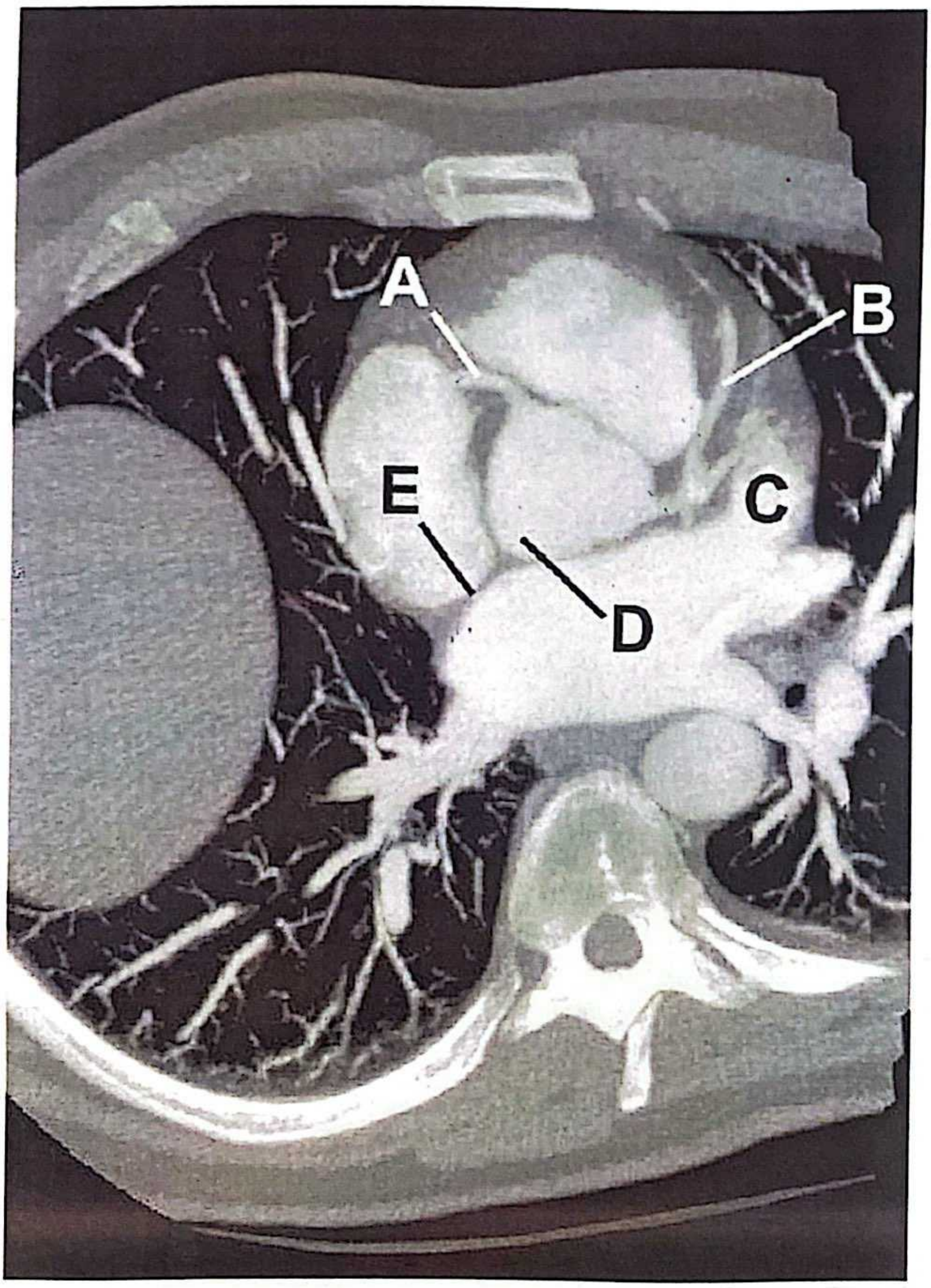


CHEST

IDENTIFY AND LABEL
(2017)


Right Lung
Manubrium
Mediastinal Fat & Fascia
Left Lung
Ascending Aorta
Pulmonary Blood Vessel
Superior Vena Cava
Azygos Vein
Trachea
Esophagus
Descending Aorta
Vertebral Body
Pedicle
R
Transverse Process
Lamina
Spinal Cord

Q.1 (2017)

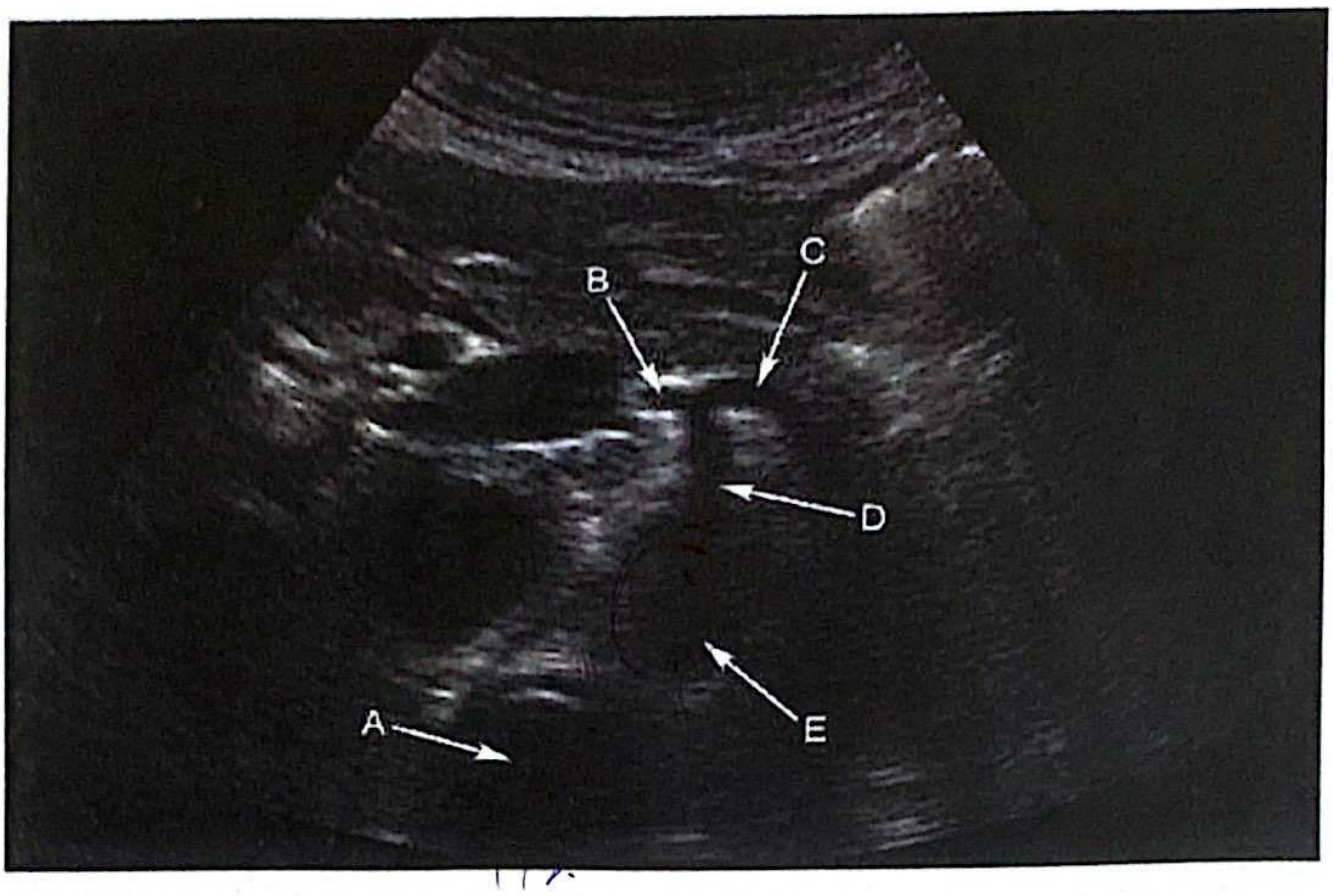


CT chest with intravenous contrast, maximum intensity projection, axial section

a Right coronary artery (RCA)
b Left anterior descending (LAD) artery
c Left atrial appendage
d Non-coronary (or posterior coronary) sinus
e Interatrial septum

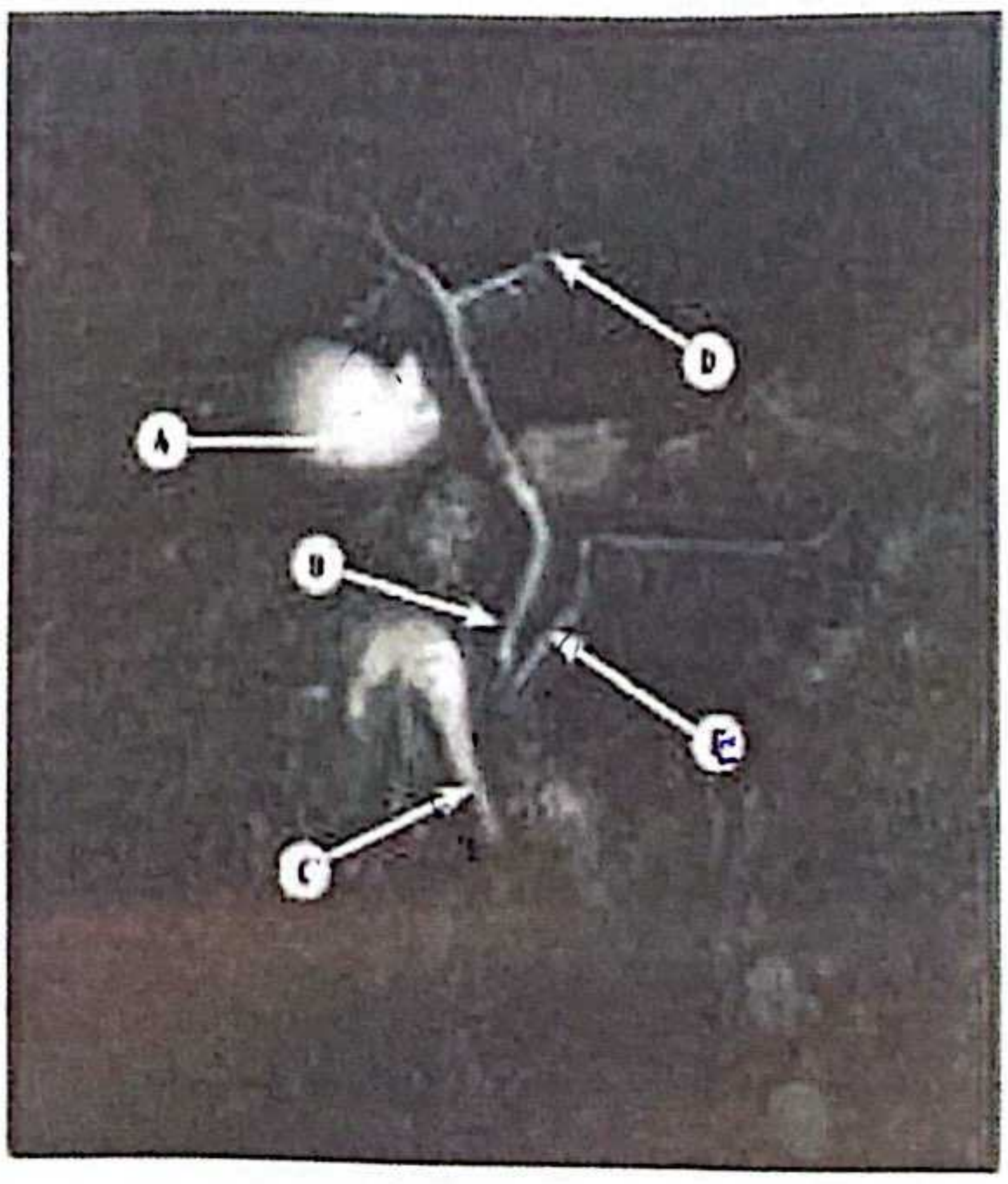
ABDOMEN

Q.1) **(2016**

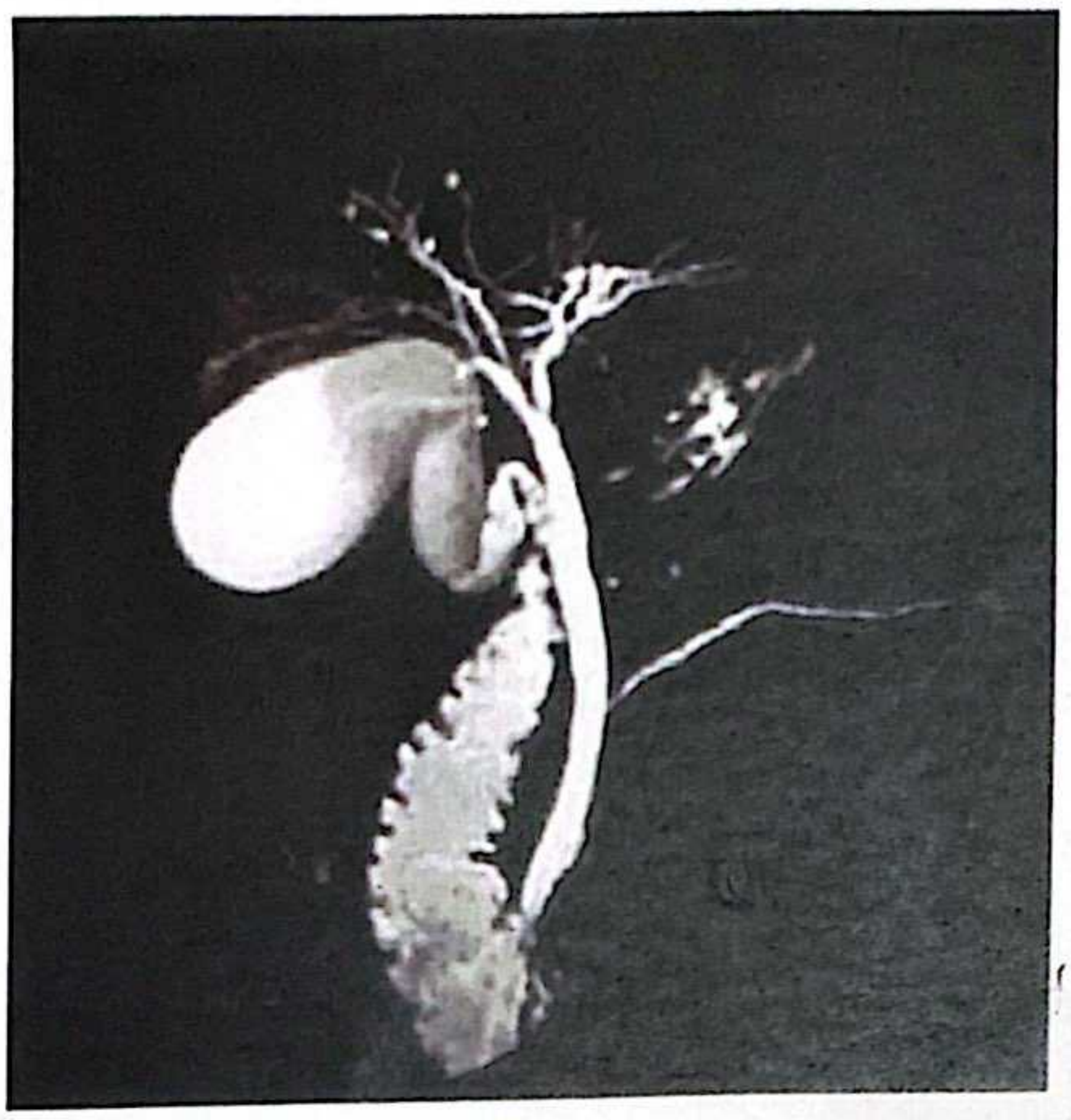


Transverse ultrasound of the abdomen
A T12.
B Common hepatic artery.
C Splenic artery.
D Coeliac trunk or axis.
E Aorta.

Q.2) **(2015)**

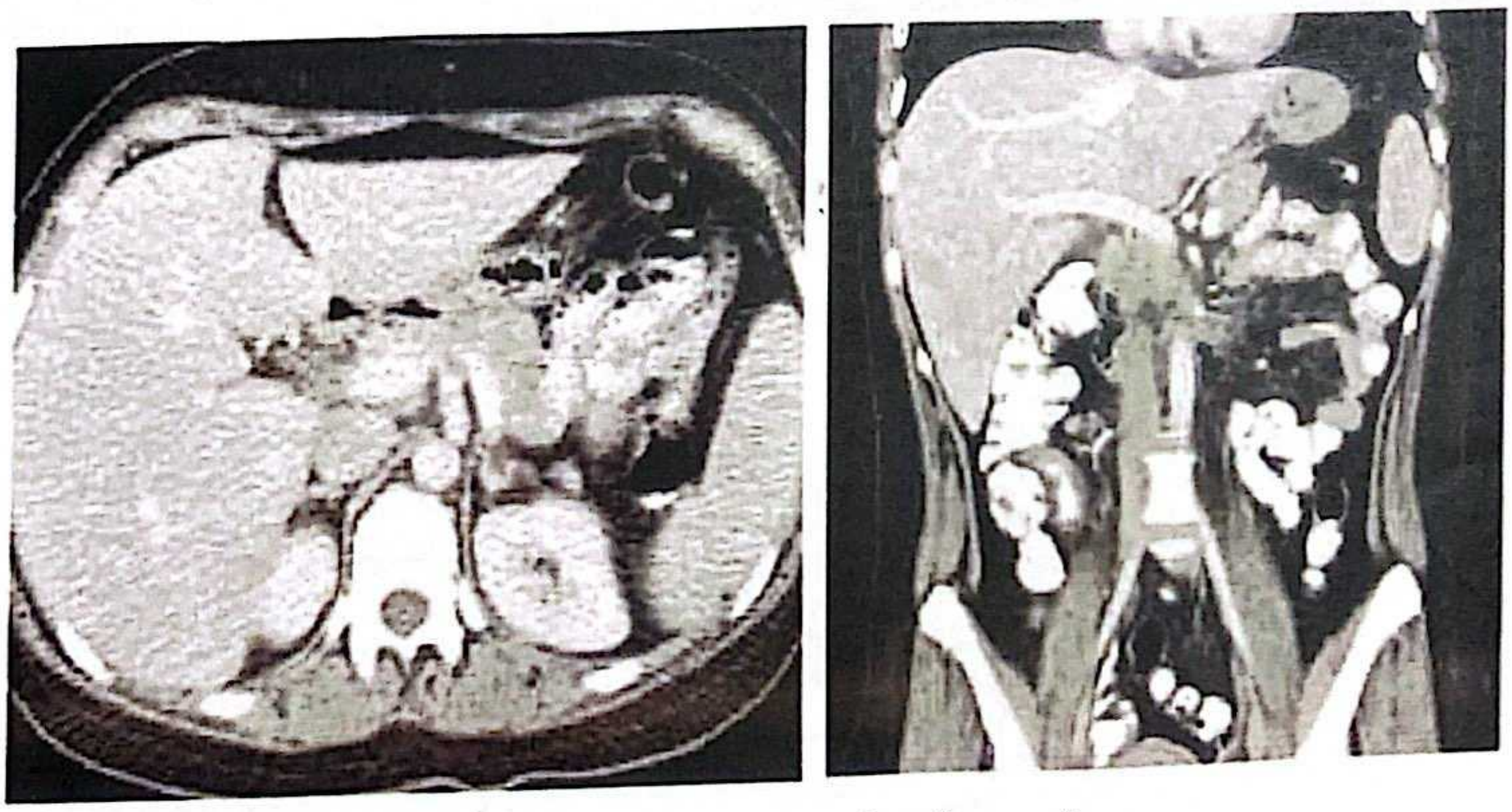


A Gallbladder
B Common bile duct
C Right proximal ureter
D Left hepatic duct
E Main pancreatic duct
MR cholangio-pancreatogram (MRCP).



a) Cystic duct
b) Cbd
c) Pancreatic duct
d) duodenum

Q.3) (2014)

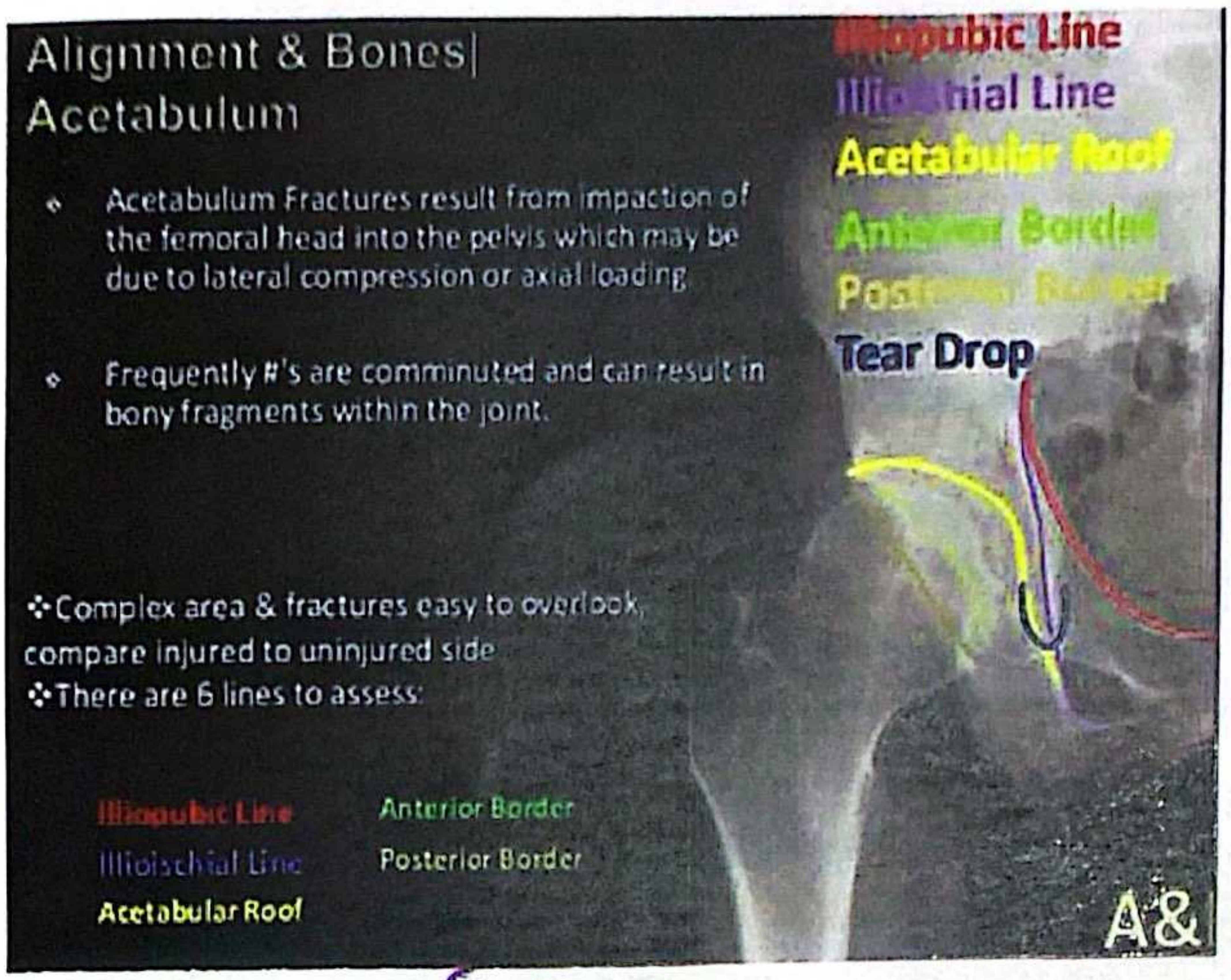


CT abdomen, post contrast study, coronal reformate:
Identify

A. Stomach
B. Cecum
C. Portal vein
D. Right common iliac artery

PELVIS

Q.1) **(2015),(2016),(2018)**



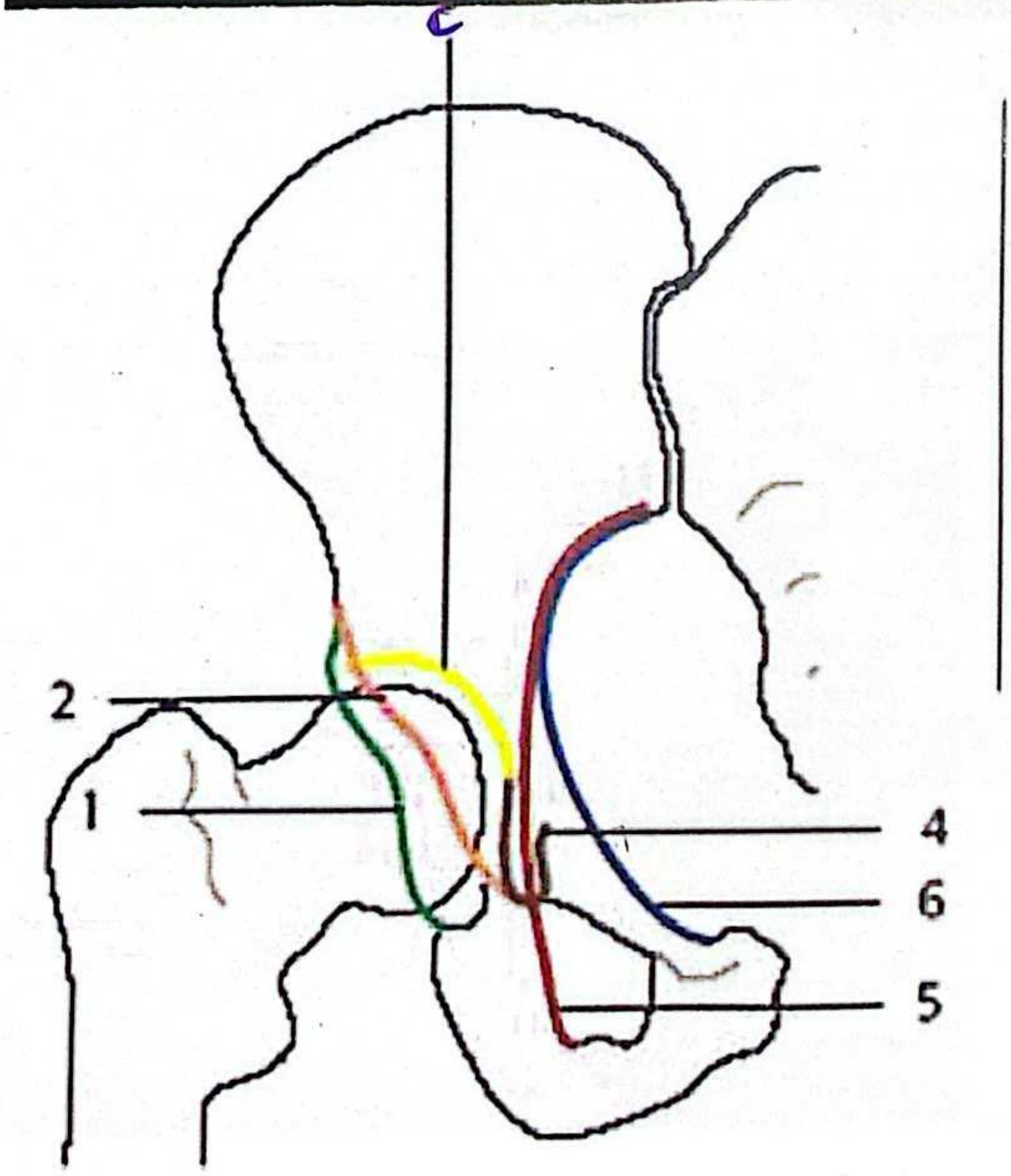
Alignment & Bones| Acetabulum

- Acetabulum Fractures result from impaction of the femoral head into the pelvis which may be due to lateral compression or axial loading
- Frequently #'s are comminuted and can result in bony fragments within the joint.

❖Complex area & fractures easy to overlook, compare injured to uninjured side
❖There are 6 lines to assess:

Illiopubic Line	Anterior Border
Illioischial Line	Posterior Border
Acetabular Roof	

Illiopubic Line
Illioischial Line
Acetabular Roof
Anterior Border
Posterior Border
Tear Drop
A&


c
2
1
4
6
5

The six fundamental radiographic landmarks of Letournel:
posterior wall of the acetabulum (1),
anterior wall of the acetabulum (2),
roof (dome or tectum) (3),
teardrop (4),
ilioischial line (posterior column) (5),
iliopectineal line (anterior column) (6)

Q.2) **(2015**

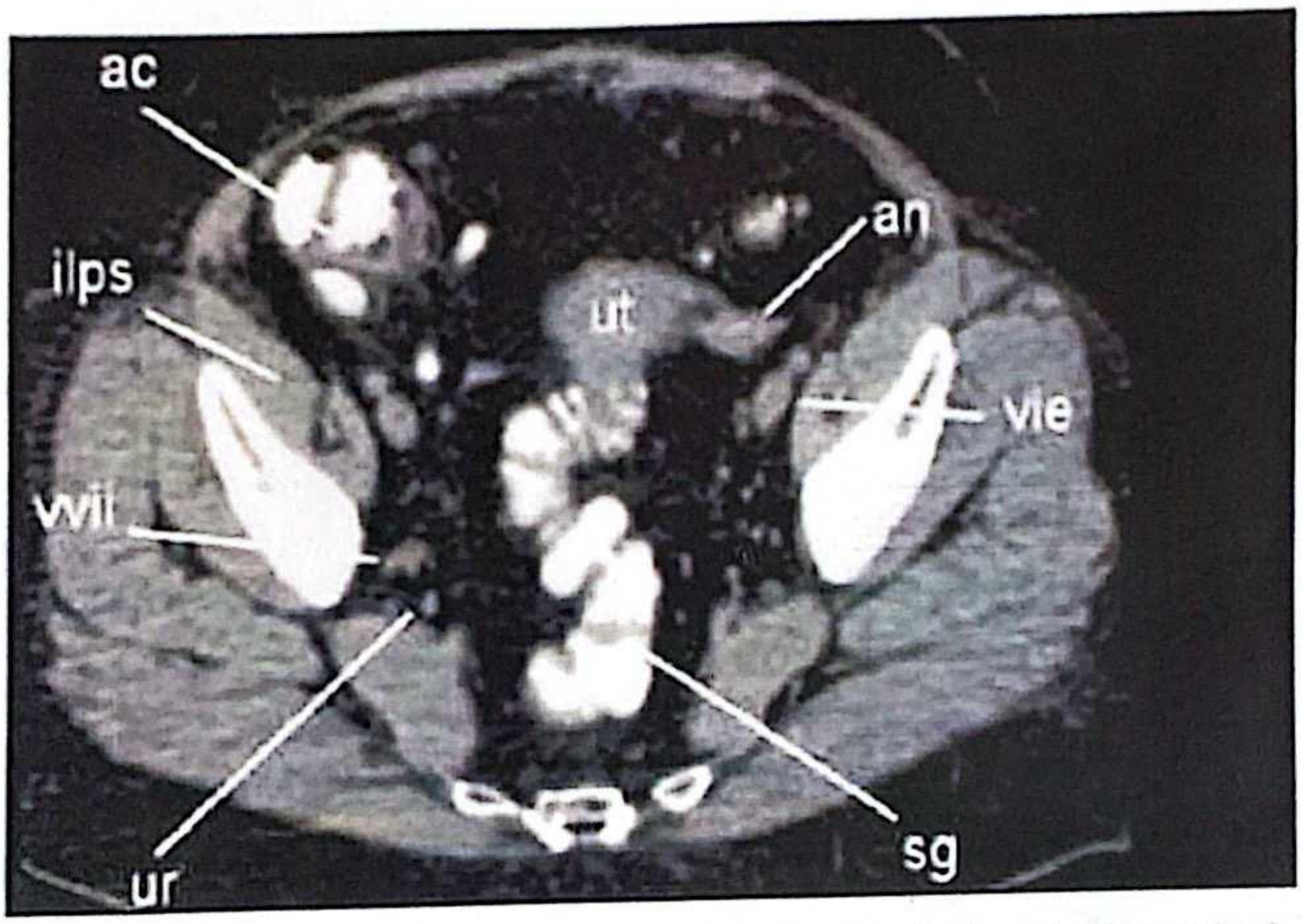
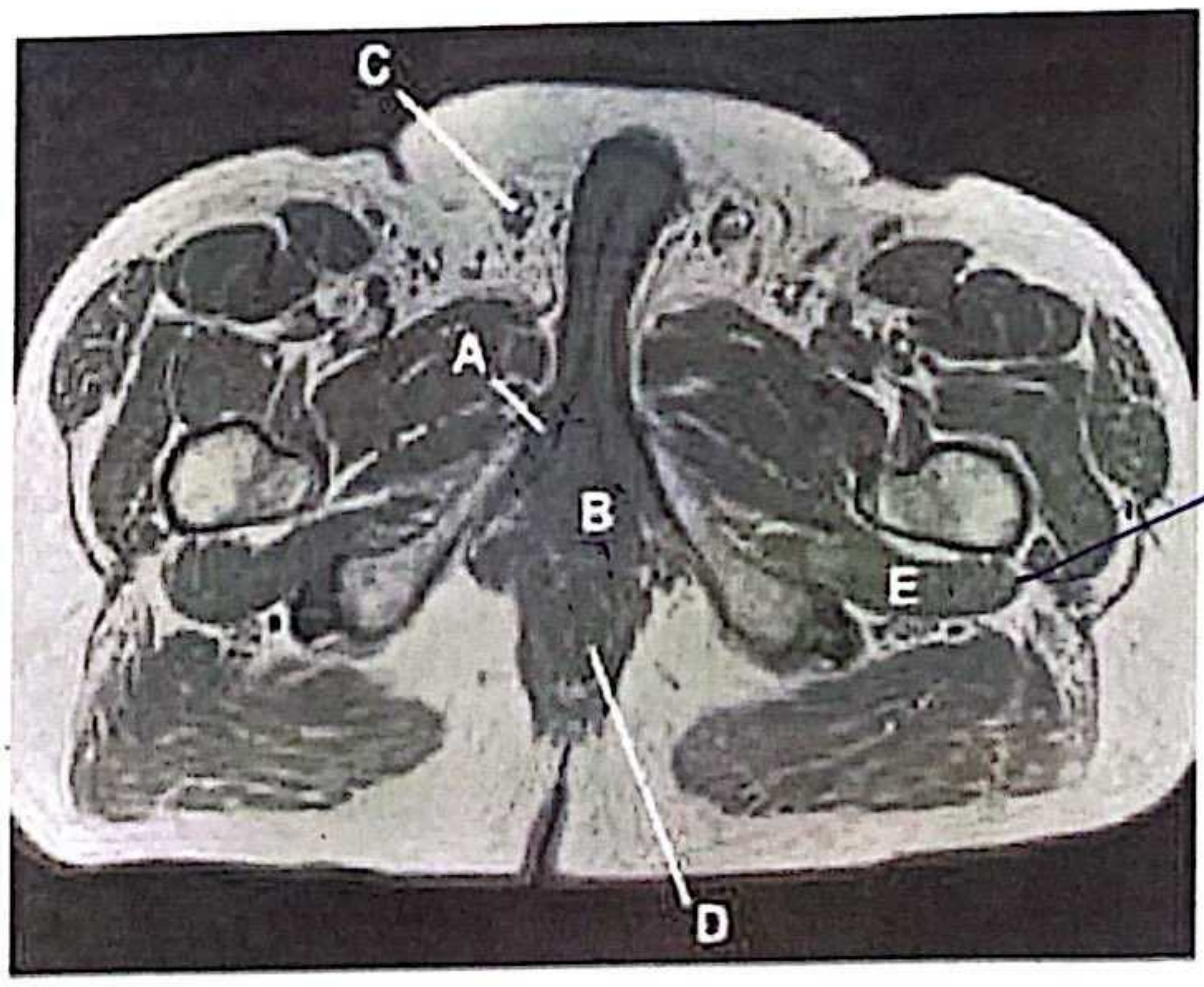


Figure 1. View through a female midpelvis. Uterus (ut) and adnexa (an), external iliac vessels (vie), internal iliac vessels (wii), colic loop (ac), sigmoid loop (sg), ureter (ur) and iliopsoas muscle (ilps).

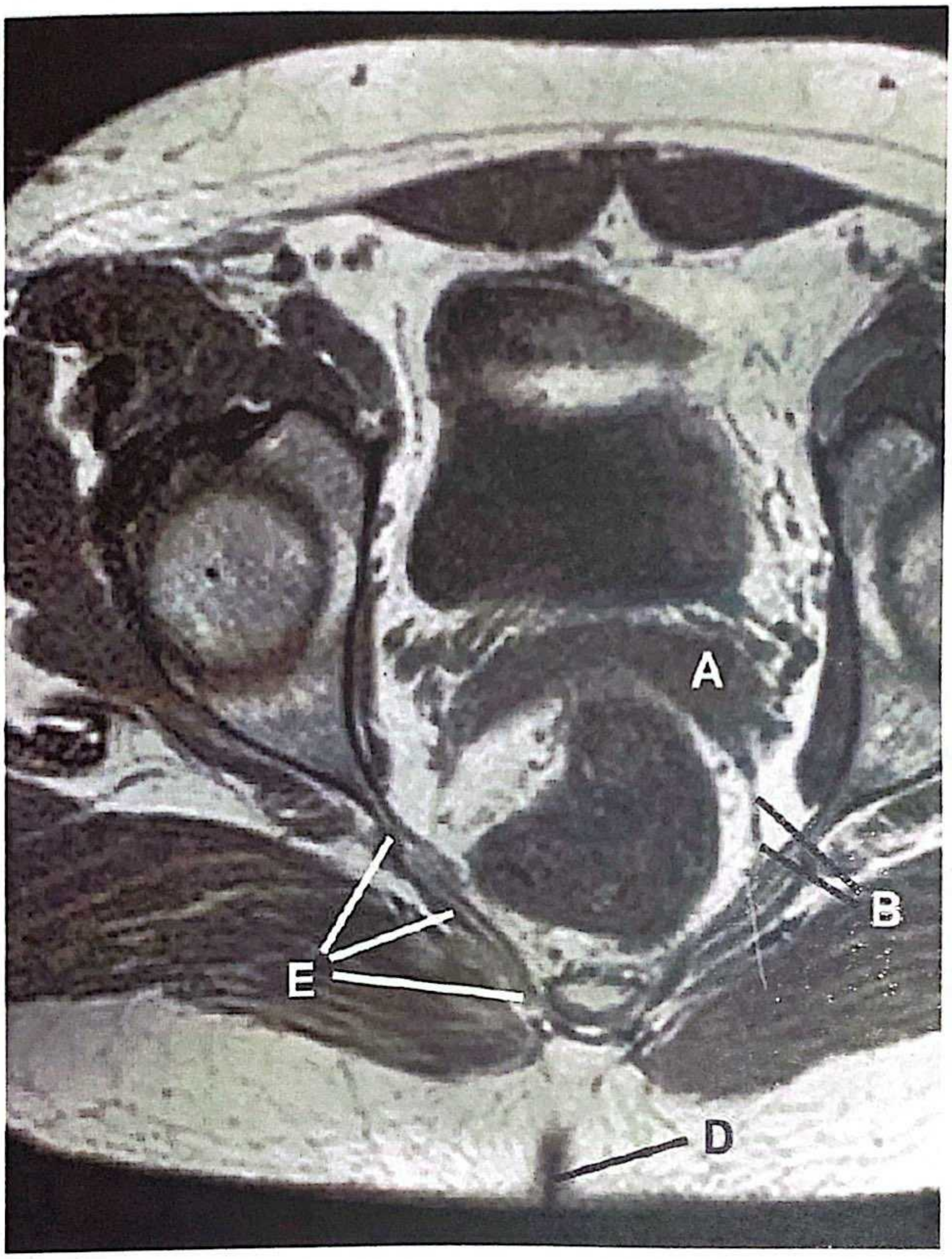
Q.3) **(2015)**



ob

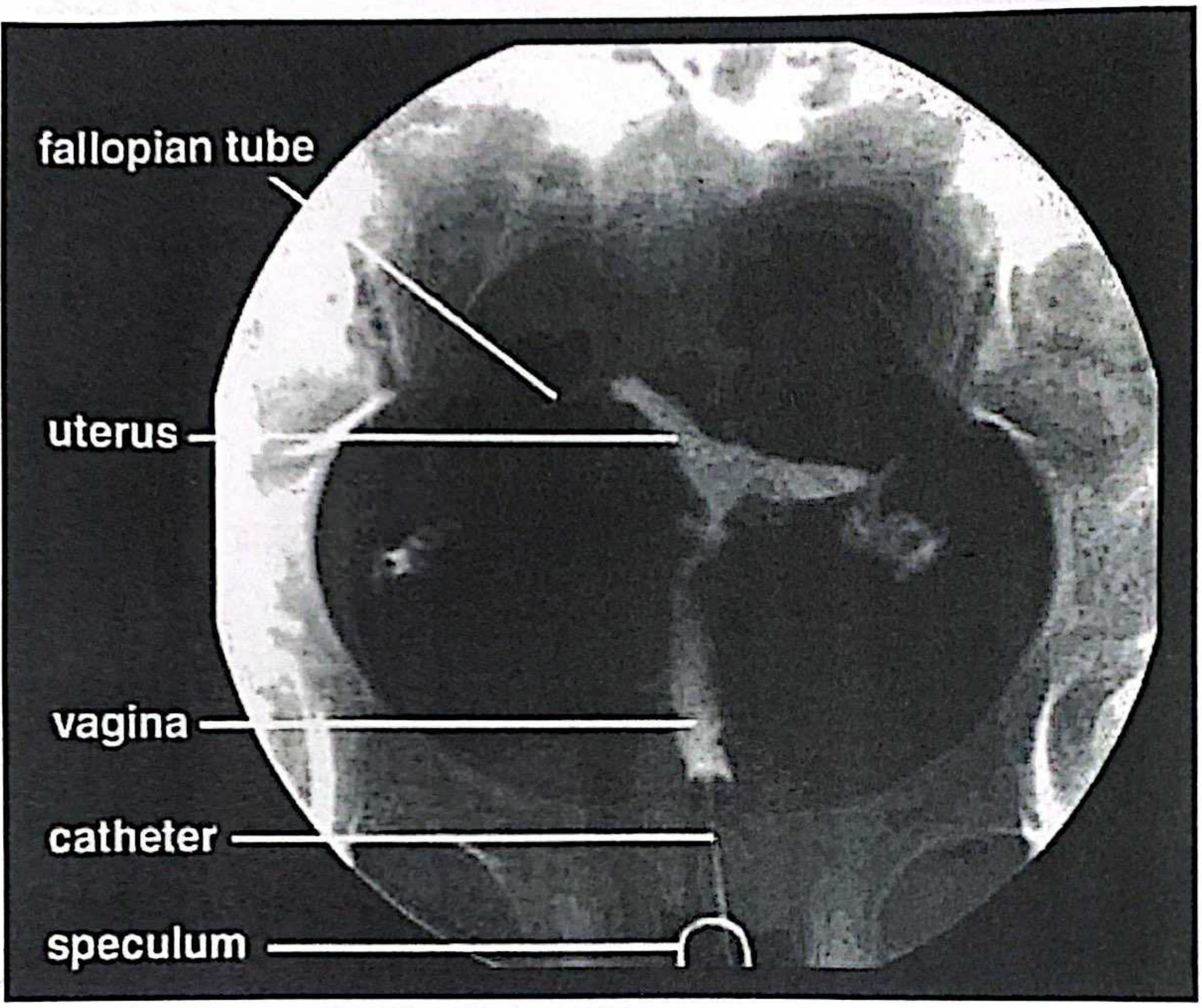
a Ischiocavernosus muscle
b Bulbospongiosus muscle
c Spermatic cord
d External anal sphincter
e The obturator externus is one of the external rotators of the hip
T1W MRI of male pelvic floor, axial slice

Q.4) (2015)



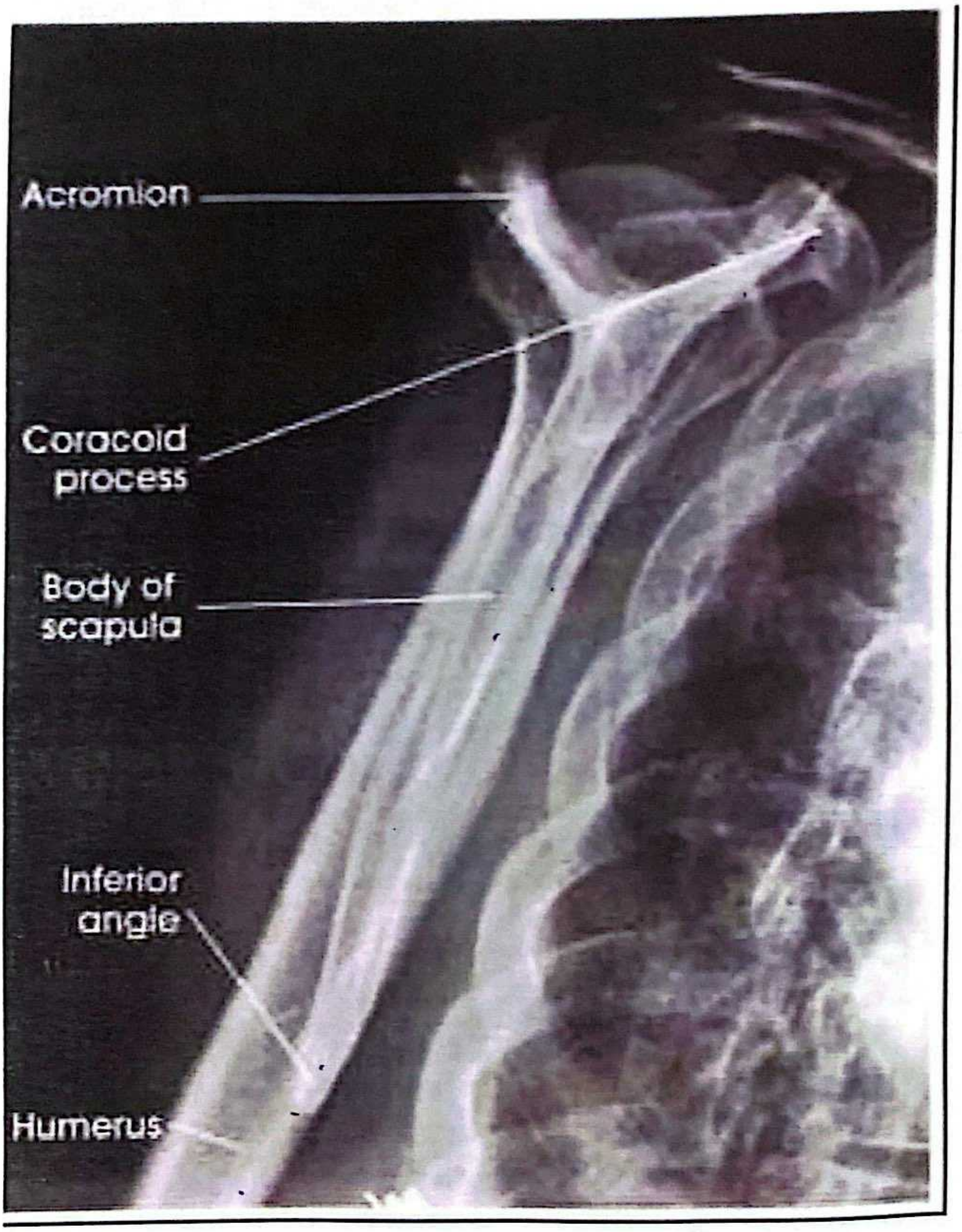
a Seminal vesicle
b Perirectal/mesorectal fascia
c Perirectal and pararectal fat
d Natal cleft

Q.5) Salphingiography (2018)

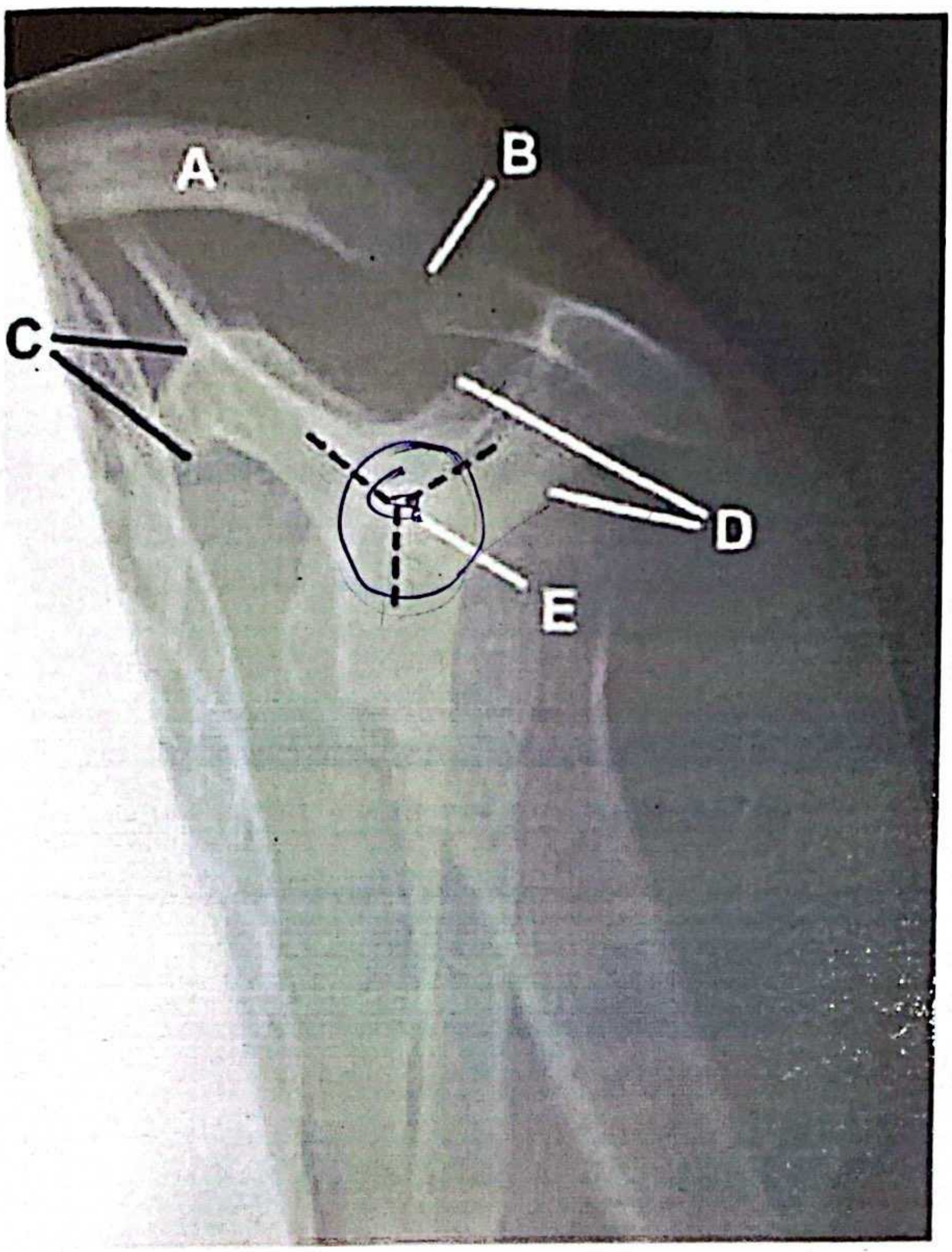

fallopian tube
uterus
vagina
catheter
speculum

UPPER LIMB

SPOT 10 IDENTIFY THE VIEW AND LABEL (2017)


Acromion
Coracoid process
Body of scapula
Inferior angle
Humerus

(2017)

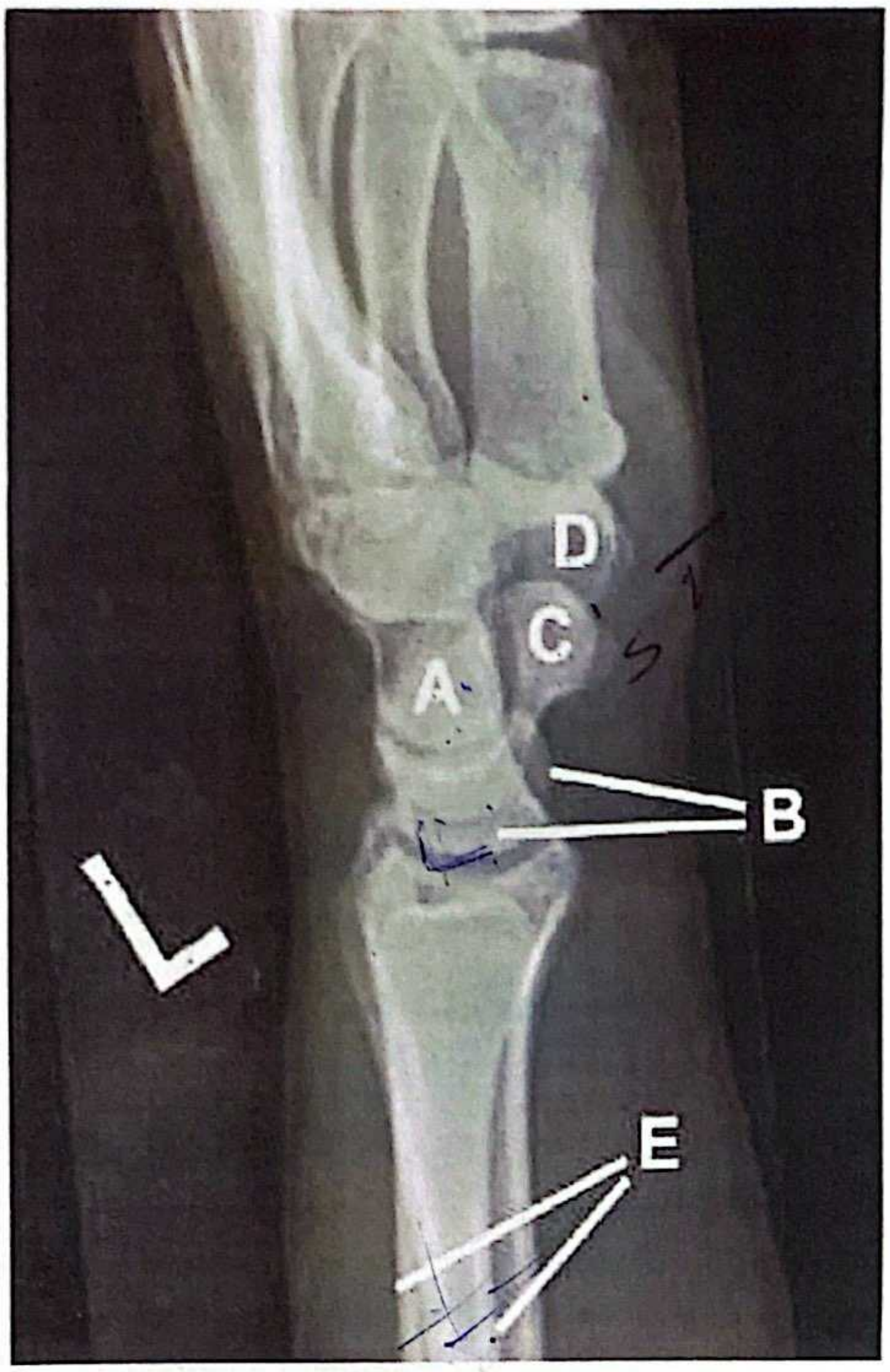


A. Clavicle
B. Acromio-clavicular joint space
C. Coracoid process
D. Spine of the scapula
E. Glenoid cavity

Trans-scapular radiograph of the shoulder

The trans-scapular view of the shoulder is predominantly used to determine whether the humeral head articulates normally with the glenoid. The glenoid is identified as the point where the coracoid process, body and spine of the scapula meet; the humeral head should be projected centrally over this area. For further orientation, the coracoid process faces anteriorly (to the left of the image provided here).

(2017)



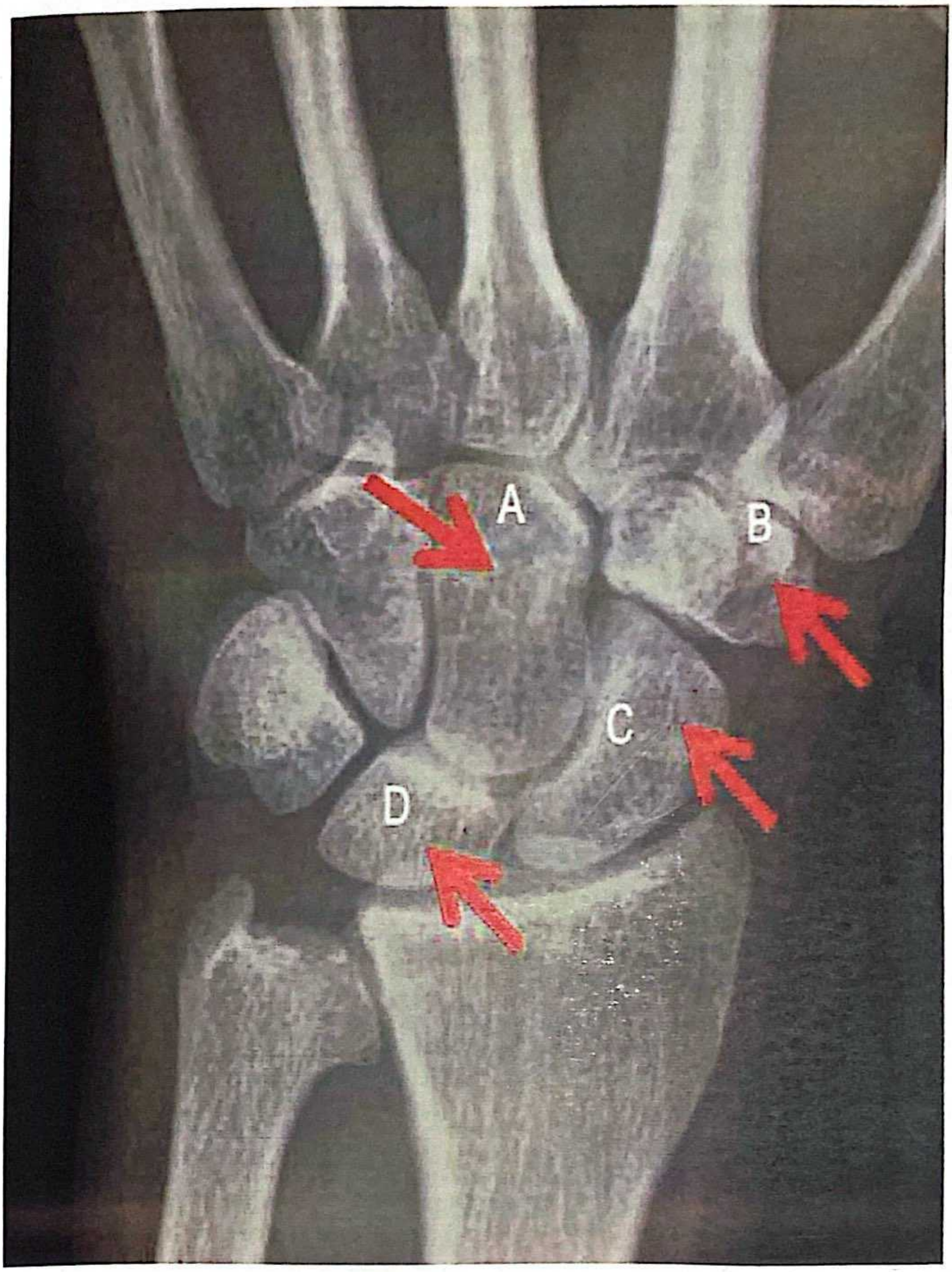
A. Capitate
B. Lunate
C. Scaphoid
D. Trapezium
E. Ulna

Radiograph of wrist, lateral view

When viewed laterally, the lunate normally rests within the cup-shaped distal end of the radius. Similarly, the capitate sits within the distal hollow formed by the curve of the lunate; i.e. capitate sits within lunate sits within radius. This configuration is disrupted in lunate and perilunate dislocations which are best demonstrated with the lateral view. The other carpal bones are more difficult to recognize when viewed laterally as there is too much overlap, however by remembering that the

trapezium sits under the thumb, this bone can also be identified. Due to differences in the appearance of their styloid processes, the radius and ulna can also usually be differentiated.

(2016)



Radiograph wrist dorsopalmar view

A. Capitate

B. Trapezium

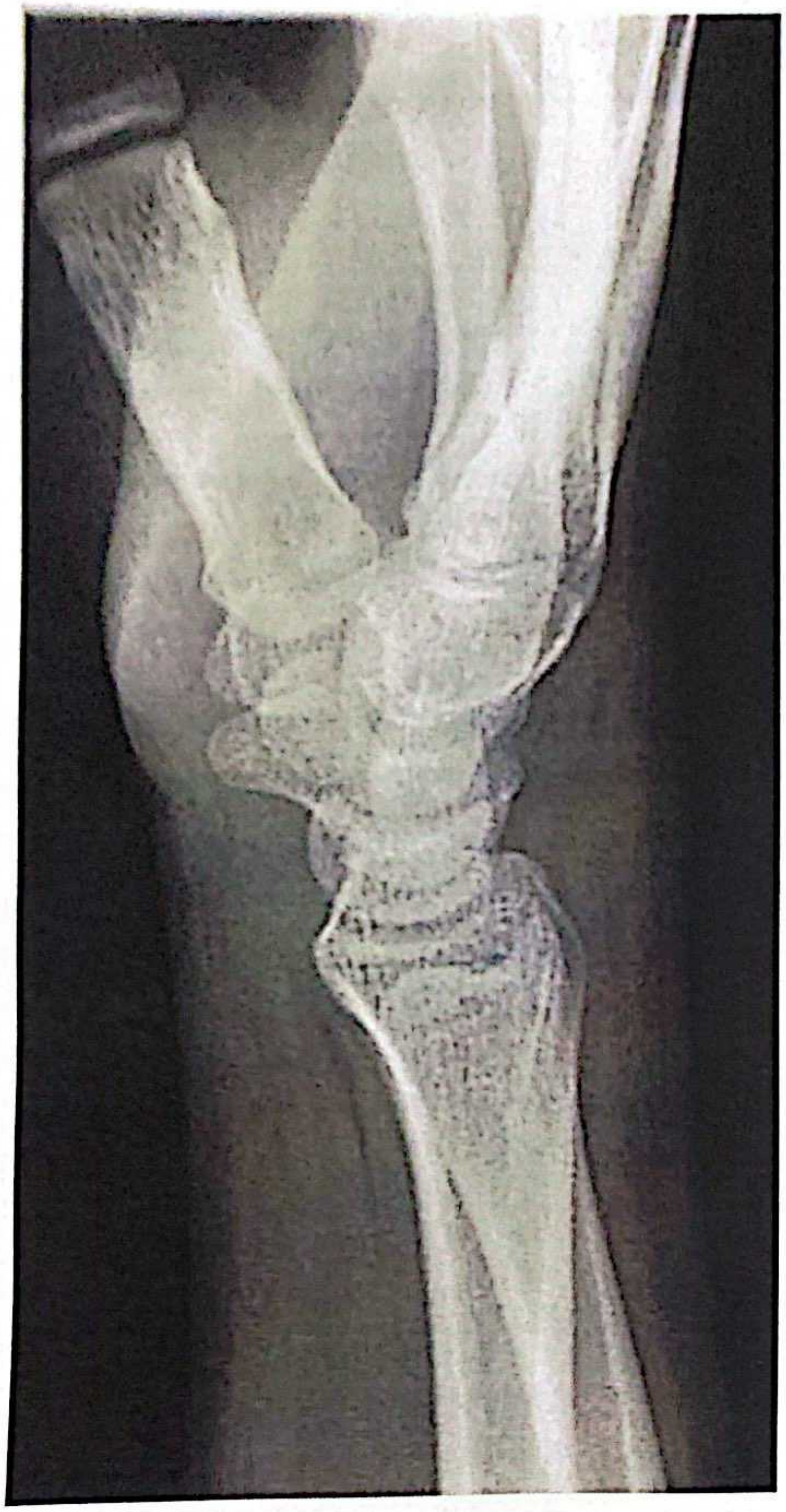
C. Scaphoid

D. Lunate

C Tz

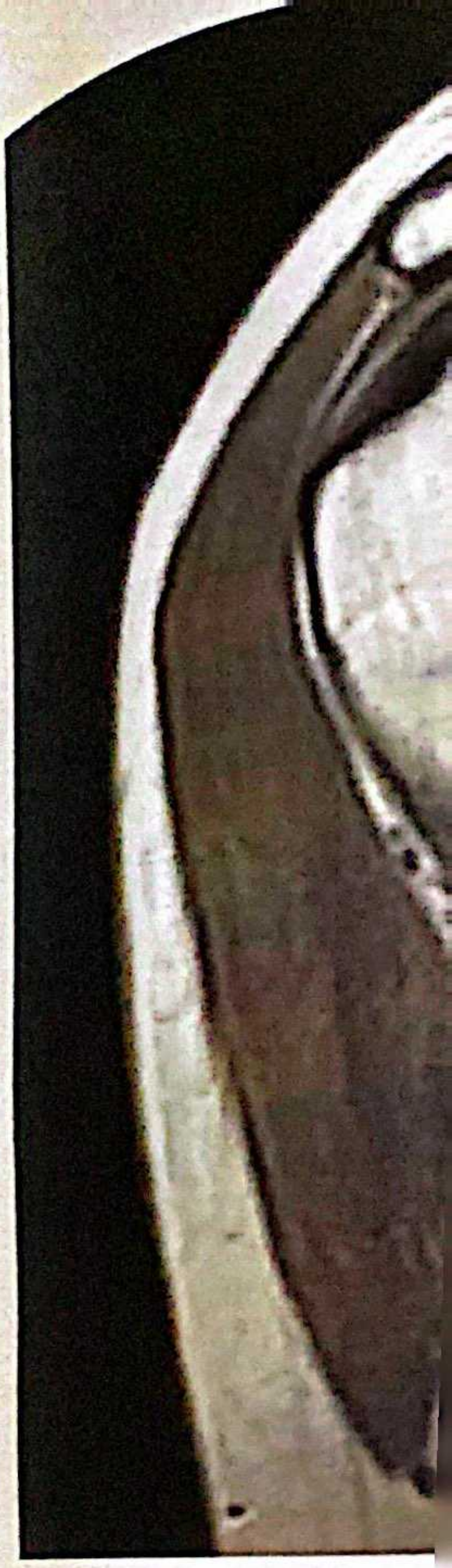
L S

(2014)



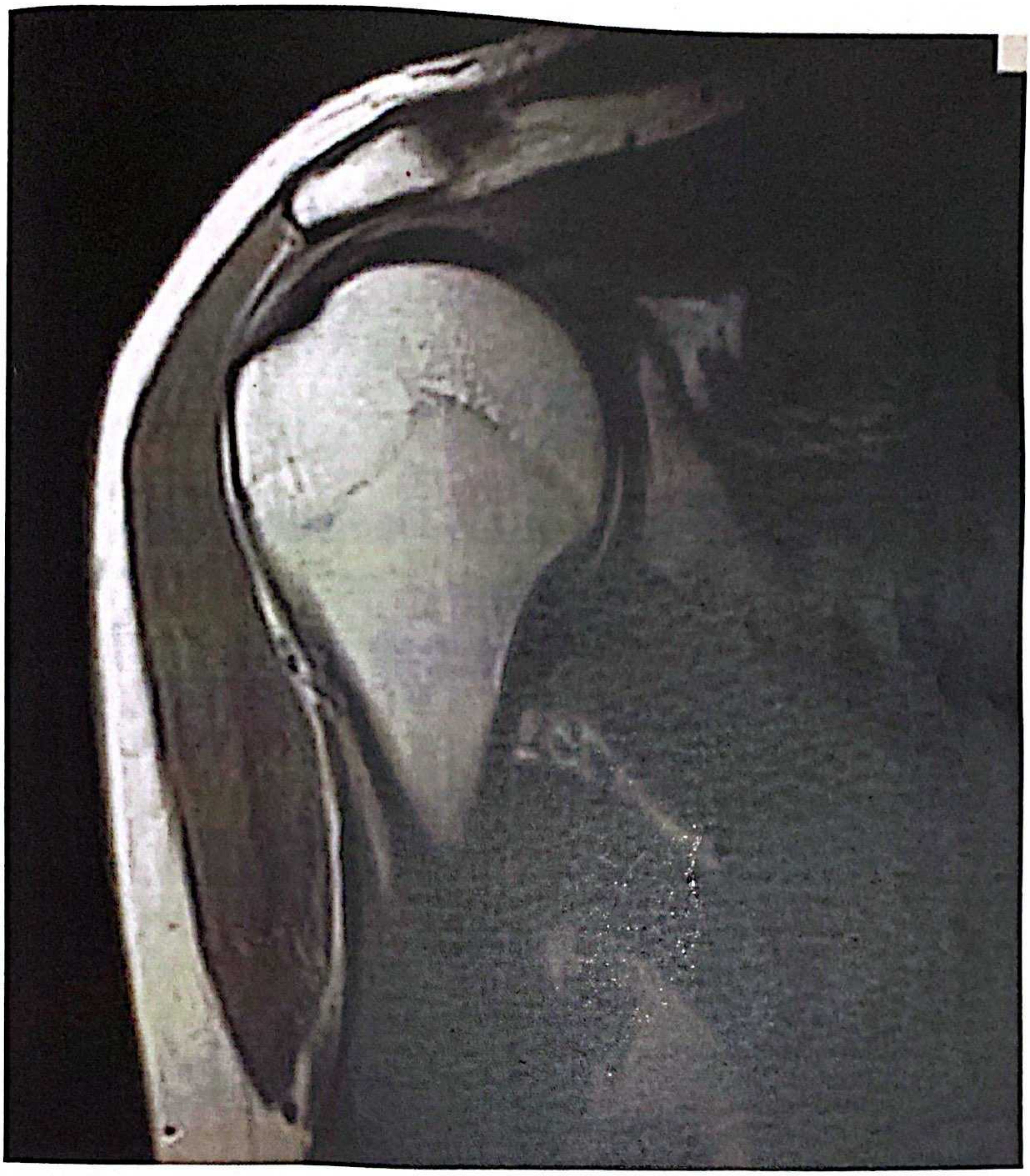
Identify the bones

A. First metacarpal
B. Trapezium
C. Scaphoid /scaphoid tubercle
D. Lunate



MRI right shoulder joi
Identify

A. Acromion
B. Supraspinato
C. Deltoid musc
D. Greater tube



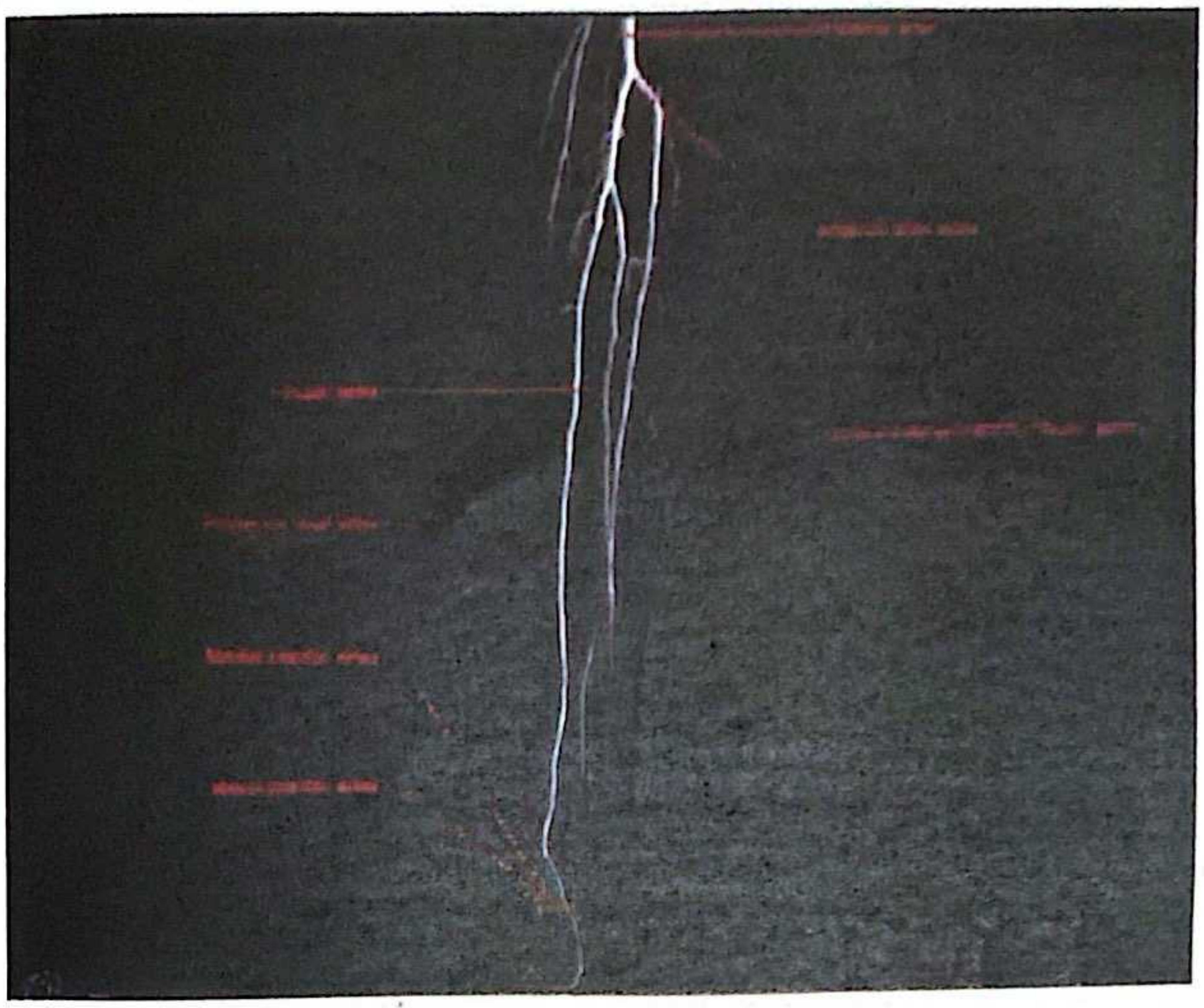
MRI right shoulder joint, T2W coronal view.
Identify

- A. Acromion
- B. Supraspinatous muscle
- C. Deltoid muscle
- D. Greater tuberosity

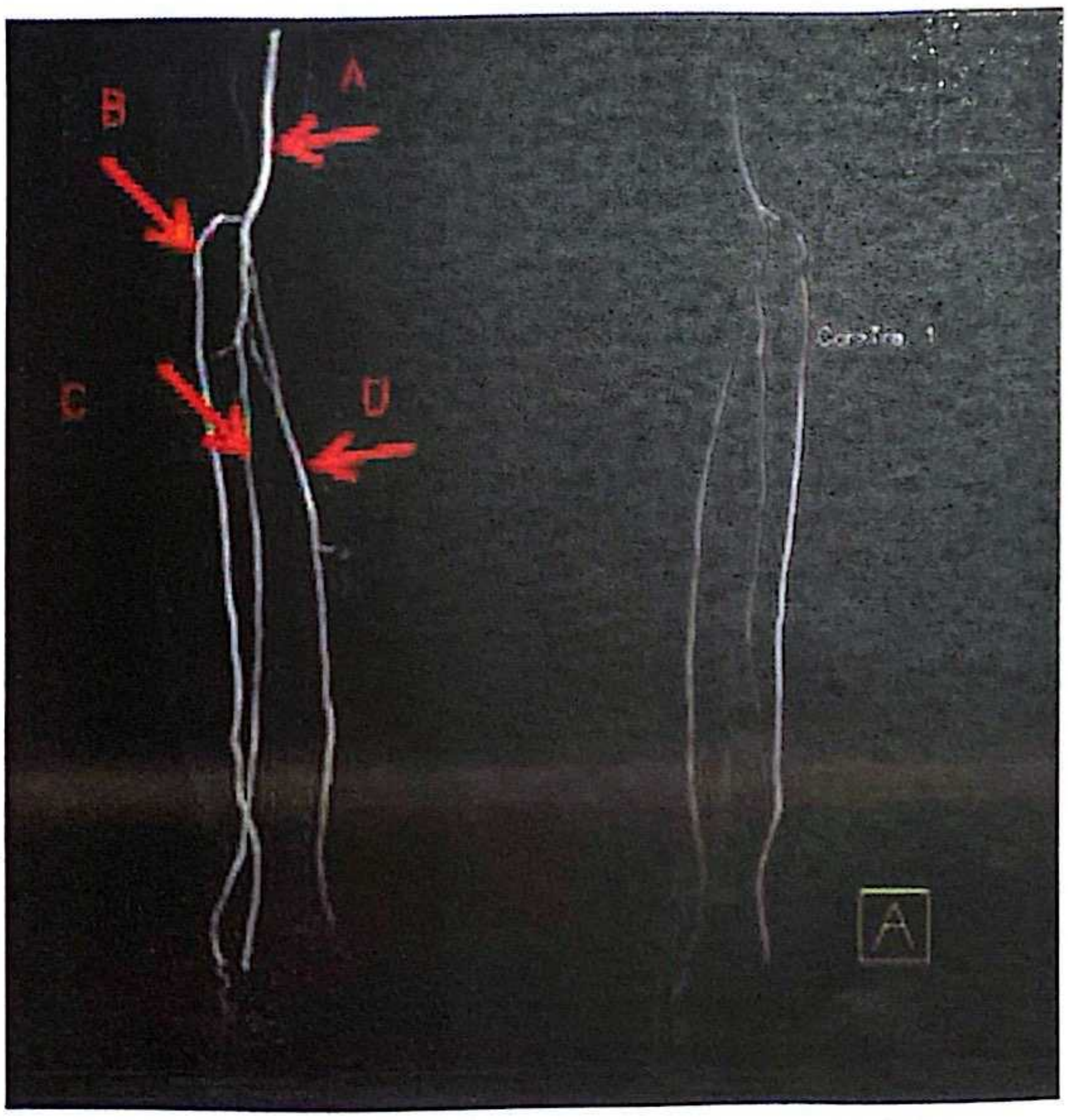
LOWER LIMB

SPOT 29 IDENTIFY AND LABEL

(2017)

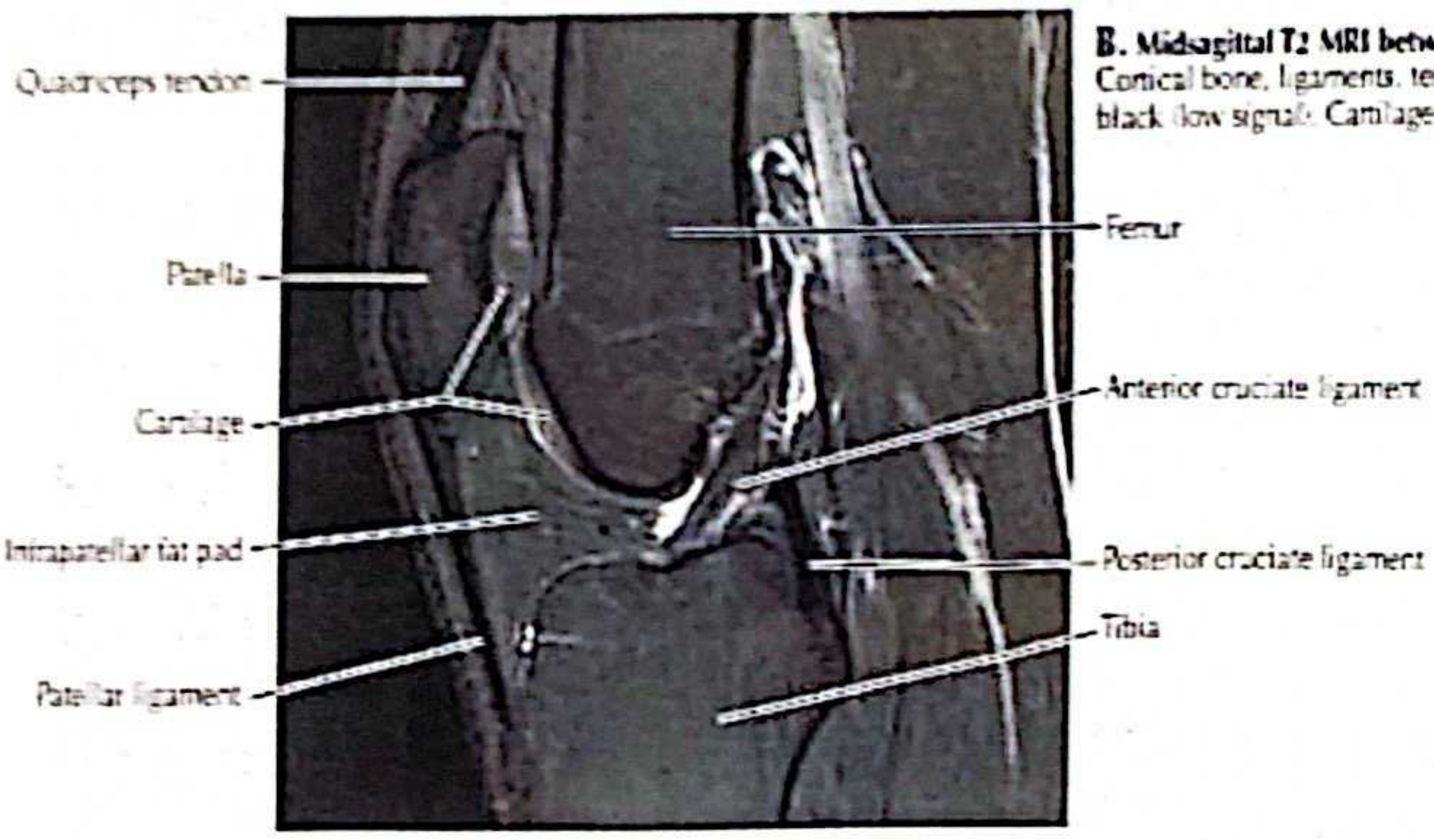


(2016)

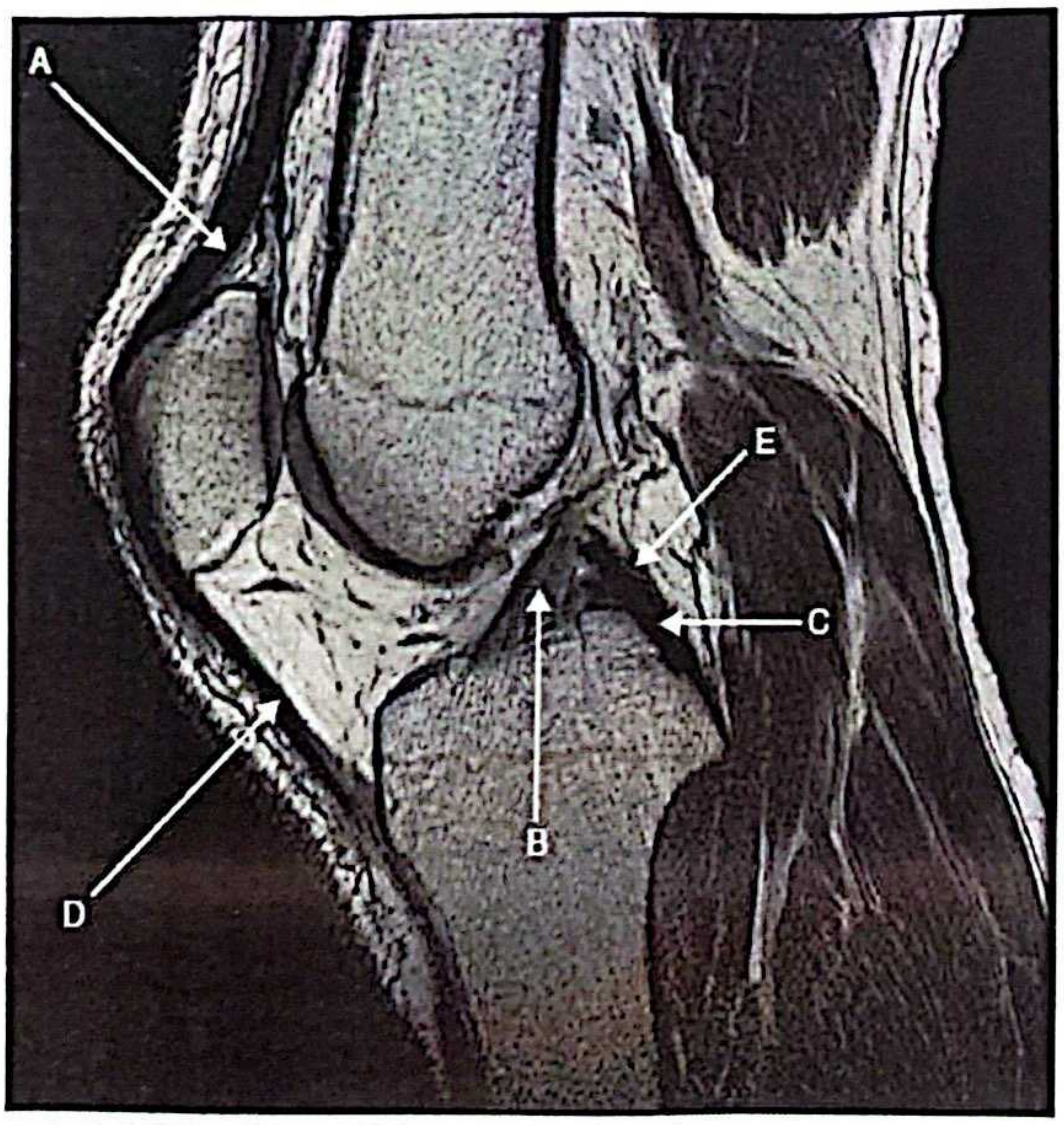


MR arteriogram of leg vessels (popliteal angiogram)
Popliteal artery
Anterior tibial Artery
Posterior tibial artery
Peroneal artery

(2017)


Quadriceps tendon
Patella
Cartilage
Infrapatellar fat pad
Patellar ligament
Femur
Anterior cruciate ligament
Posterior cruciate ligament
Tibia

B. Midsagittal T2 MRI between the femoral condyles. Cortical bone, ligaments, tendons, and menisci appear black (low signal). Cartilage is brighter (higher signal).



Sagittal T1-weighted MR knee

(a) Quadriceps tendon. This is formed by the combination of the vastus medialis, vastus intermedius, vastus lateralis and rectus femoris tendons. Rupture of this structure results in loss of knee extension.

(b) Anterior cruciate ligament (ACL). This is an important central stabilizer of the knee joint, limiting anterior tibial translation. Failure of the ACL may occur due to tears at the origin or within the mid-substance, or less commonly following avulsion of the footprint antero-lateral to the anterior tibial spine.

(c) Posterior cruciate ligament (PCL). The PCL is a strong ligament with a recently described 4-bundle structure. Tears of this ligament most commonly occur in the midsubstance.

(d) Patellar tendon. This inserts onto the tibial tuberosity. In the clinical setting of recurrent lateral patellar dislocation, the patellar tendon insertion is surgically medialized by a procedure called a 'Tibial tuberosity transfer'. This reduces the degree of lateral patellar migration during knee flexion.

(e) Posterior mensico-femoral ligament (of Wrisberg). Either the posterior (Wrisberg) or anterior (Humphrey) mensico-femoral ligaments are present in 80% of knees. They stabilize the posterior horn of the lateral meniscus and must not be mistaken for displaced meniscal tear fragments on sagittal MRI images

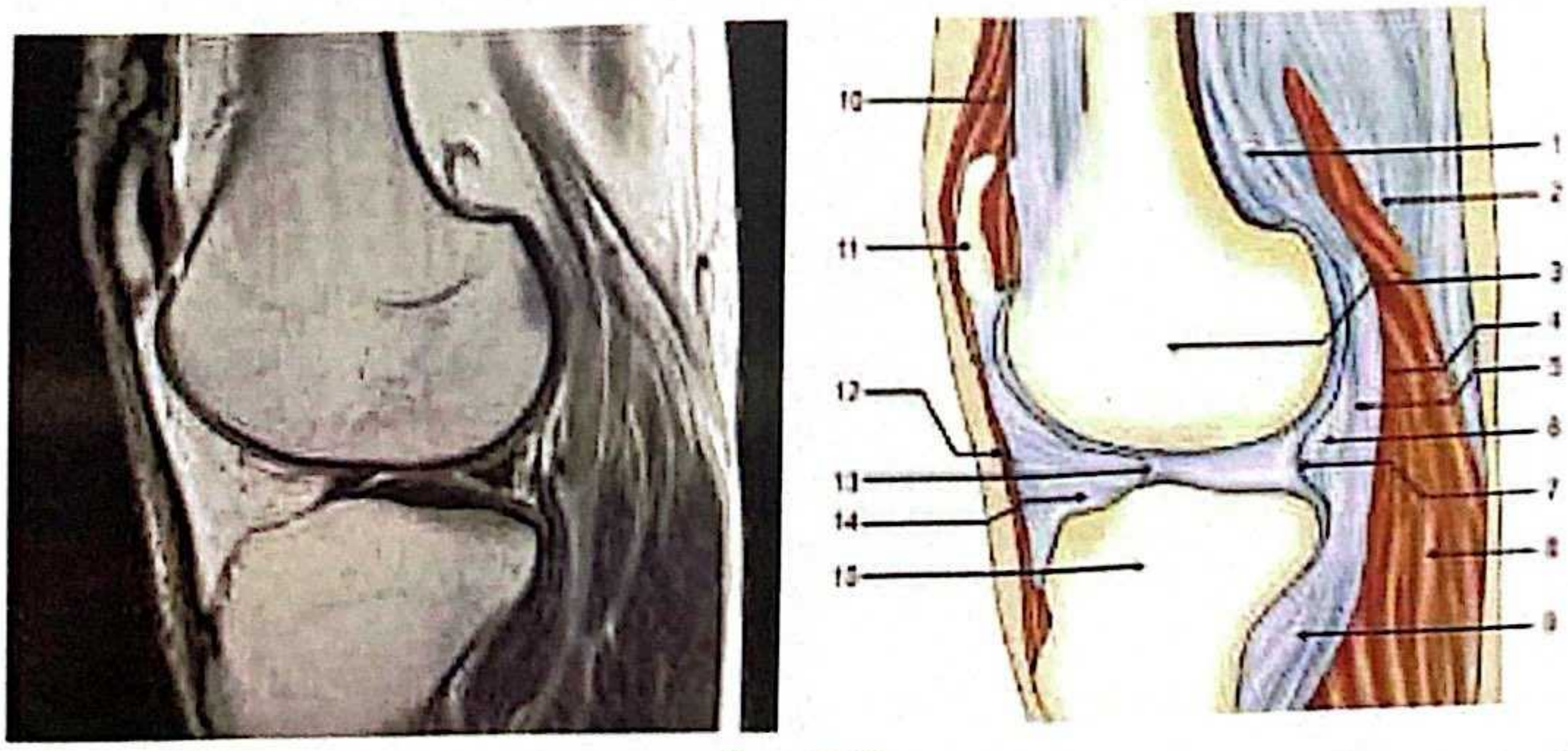
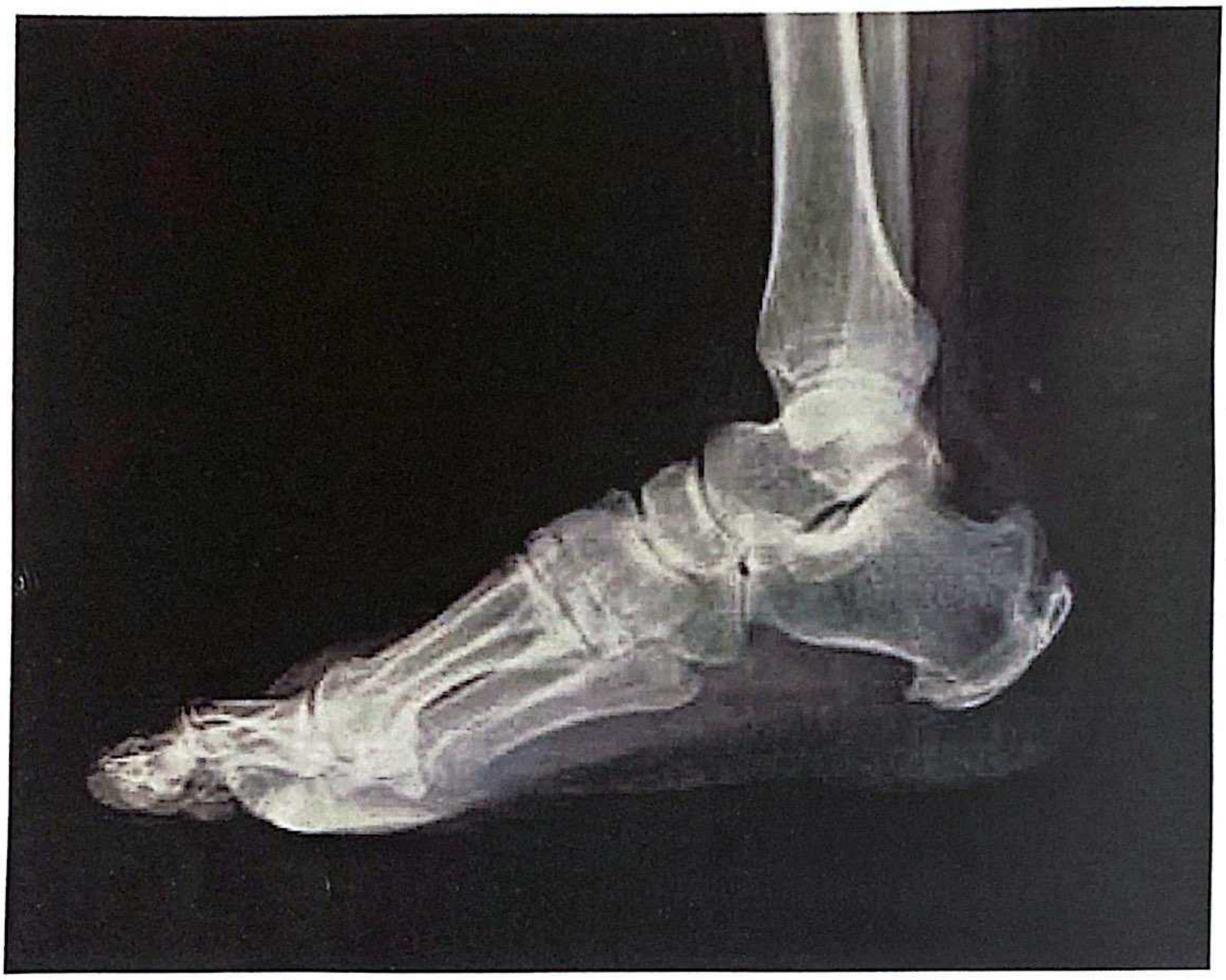


Figure 17.17

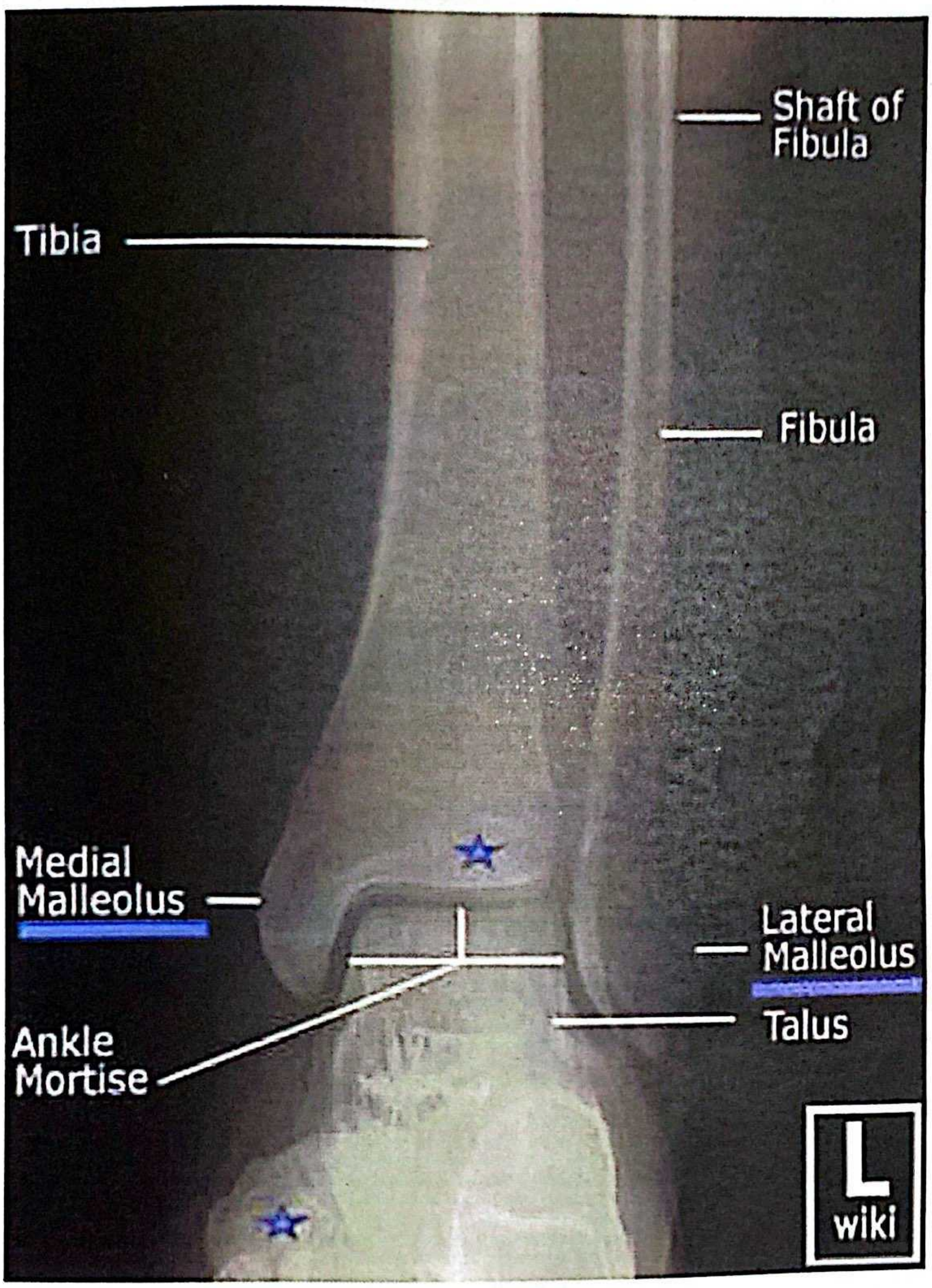
1. Superior lateral genicular artery
2. Tibial nerve
3. Femoral condyle (lateral)
4. Popliteal vein
5. Popliteal artery
6. Posterior joint capsule
7. Lateral meniscus, posterior horn
8. Gastrocnemius (lateral head)
9. Popliteus
10. Quadriceps tendon
11. Patella
12. Patellar ligament
13. Lateral meniscus, anterior horn
14. Hoffa's fat pad
15. Tibial condyle (lateral)

(2016)



Lateral radiograph of ankle.
Calcaneal enthesophytes. Thickening of soft tissue shadow of Achilles tendon with loss of margin definition is seen.
Kager's fat pad is effaced. Bone flake is noted away from calcaneum
Next: MRI ankle joint, Ultrasound Ankle

(2015)

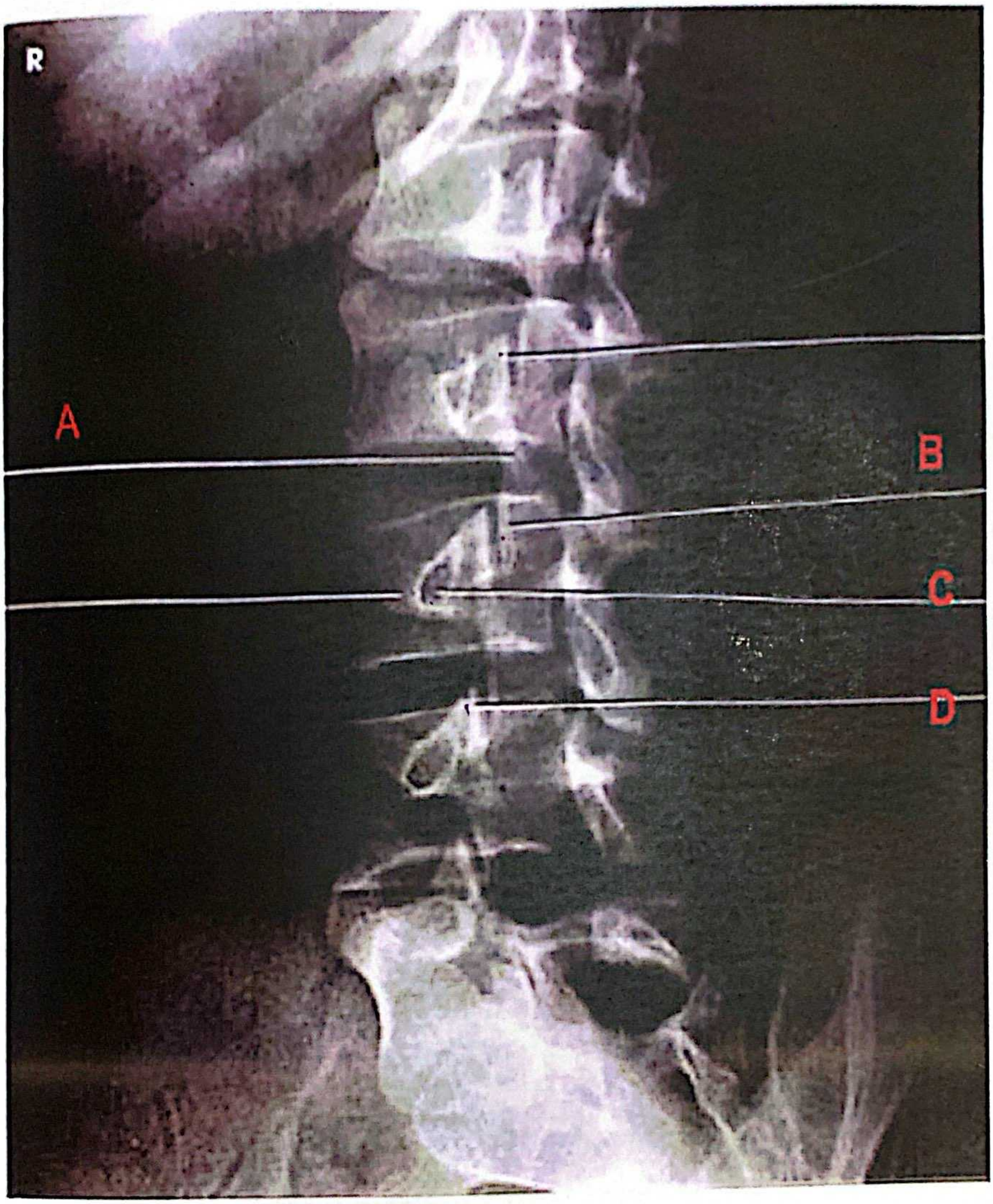

Shaft of Fibula
Tibia
Fibula
Medial Malleolus
Lateral Malleolus
Talus
Ankle Mortise
L
wiki

SPINE

RADIOGR

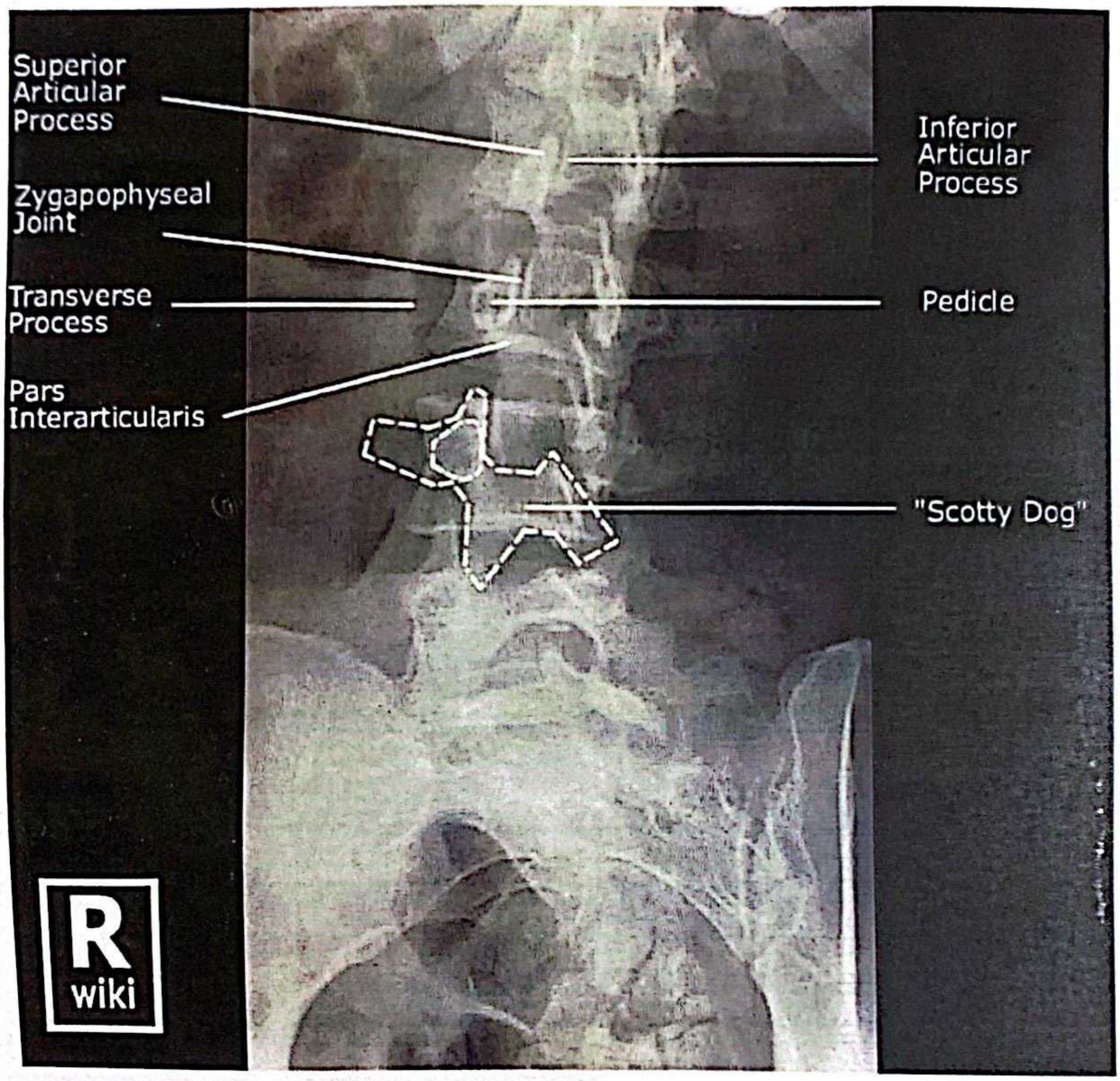
A. F
B.
C.
D.

(2016)



RADIOGRAPH LUMBAR SPINE -OBLIQUE

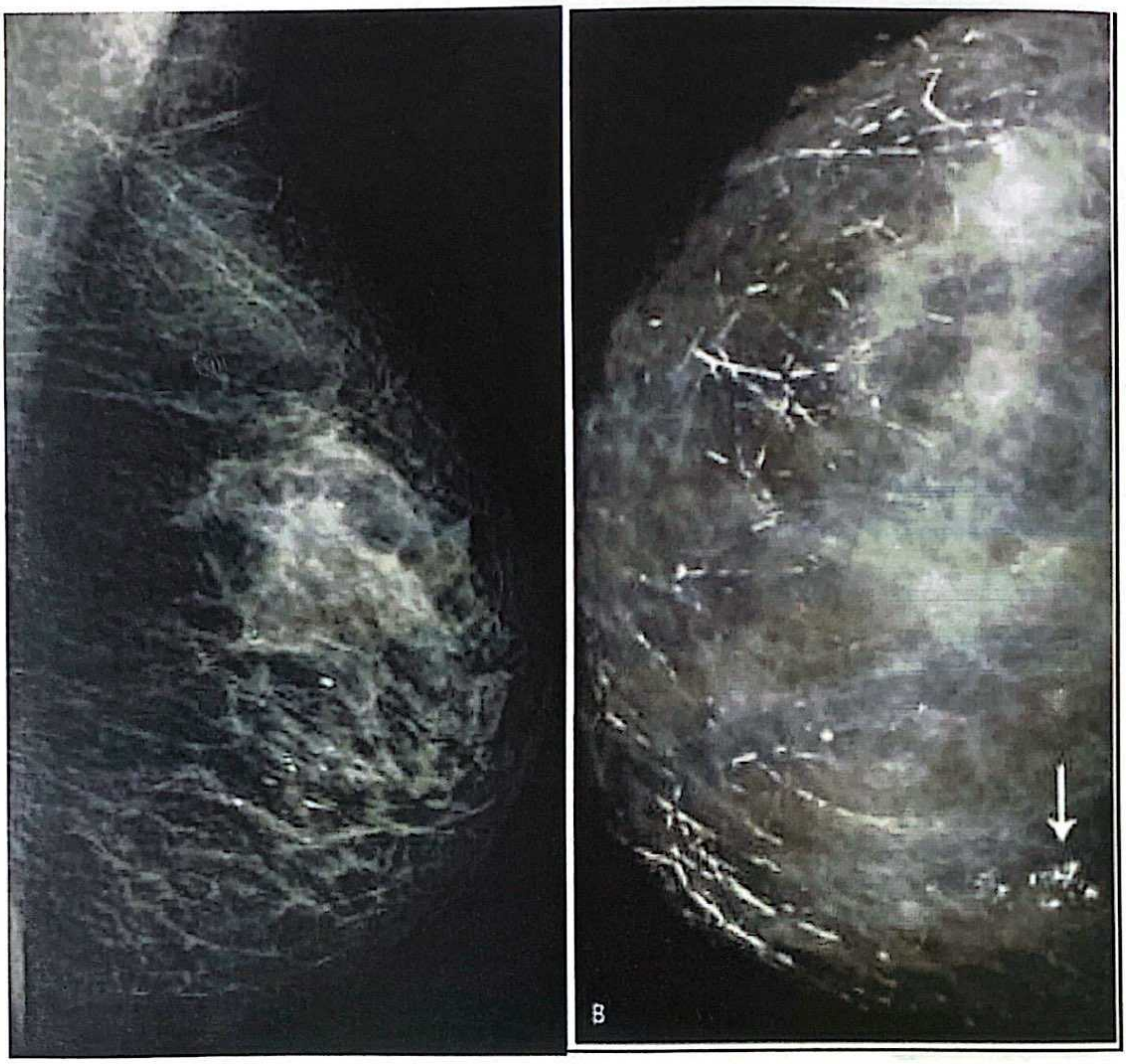
A. Pars interarticularis
B. Inferior Articular process
C. Pedicle
D. Superior Articular process


Superior Articular Process
Zygapophyseal Joint
Transverse Process
Pars Interarticularis
Inferior Articular Process
Pedicle
"Scotty Dog"
R wiki

BREAST

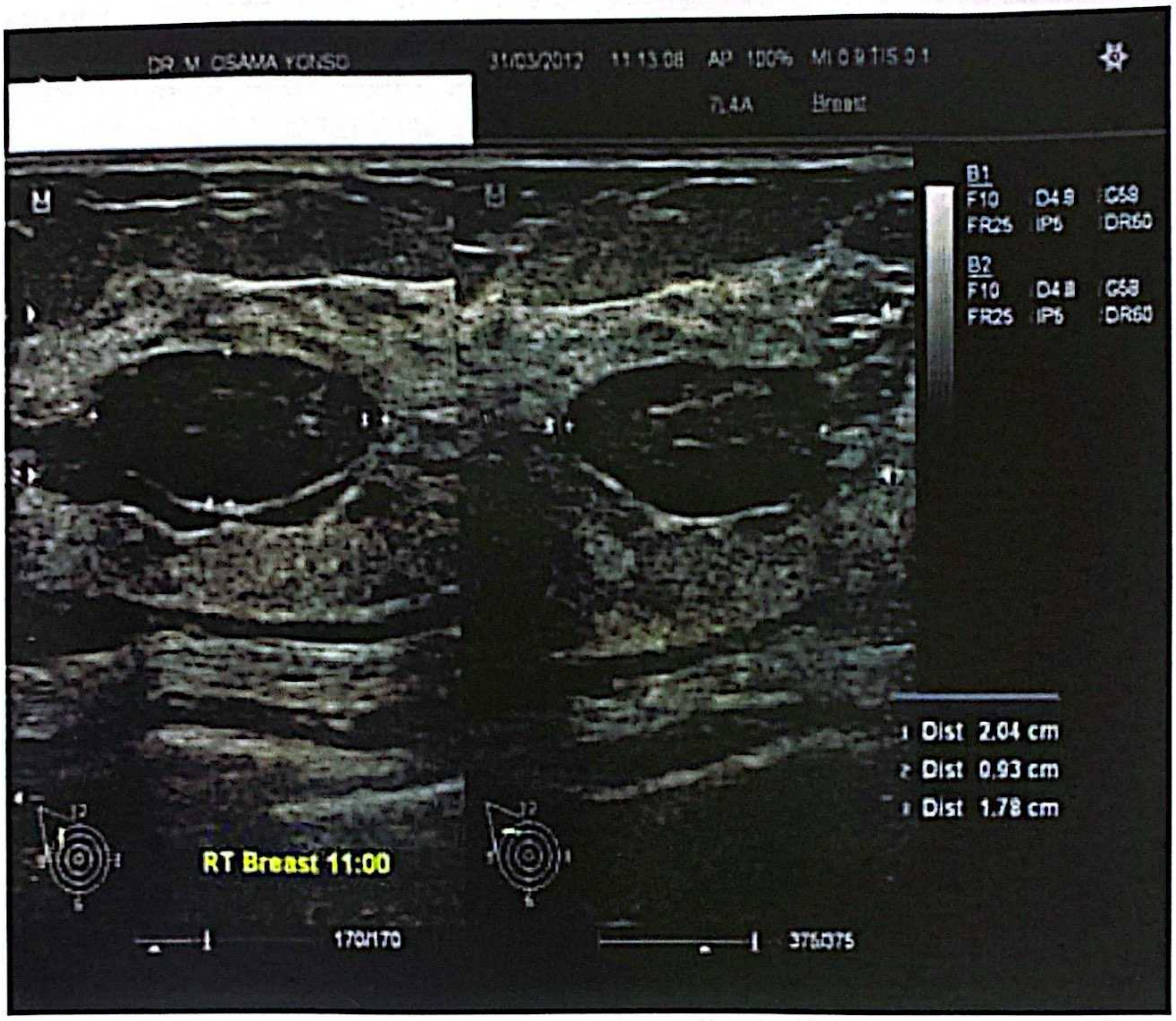
Q.1) Female 54 Came for screening

(2017)



Identify: Mammogram Breast Craniocaudal view & Mediolateral oblique view
Describe: Diffuse symmetrical in distribution smoothly calcifications seen in the breast which are thick, linear, rod-like or cigar-shaped. Long axes pointing toward the nipple with branching pattern seen.
Diagnosis: Plasma cell mastitis
What next: Counsel patient, It is a benign entity and there no increased risk of malignancy

Q.2) Breast pain-35y-Female (2016)


DR M OSAMA YONSO
31/03/2017 11:13:08 AP 100% MI 0.9 TIS 0.1
7L4A Breast
B1
F10 D4.9 G58
FR25 IP5 DR60
B2
F10 D4.8 G58
FR25 IP5 DR60
1 Dist 2.04 cm
2 Dist 0.93 cm
3 Dist 1.78 cm
RT Breast 11:00
170/170
375/375

Identify: Greyscale ultrasound right breast transverse view

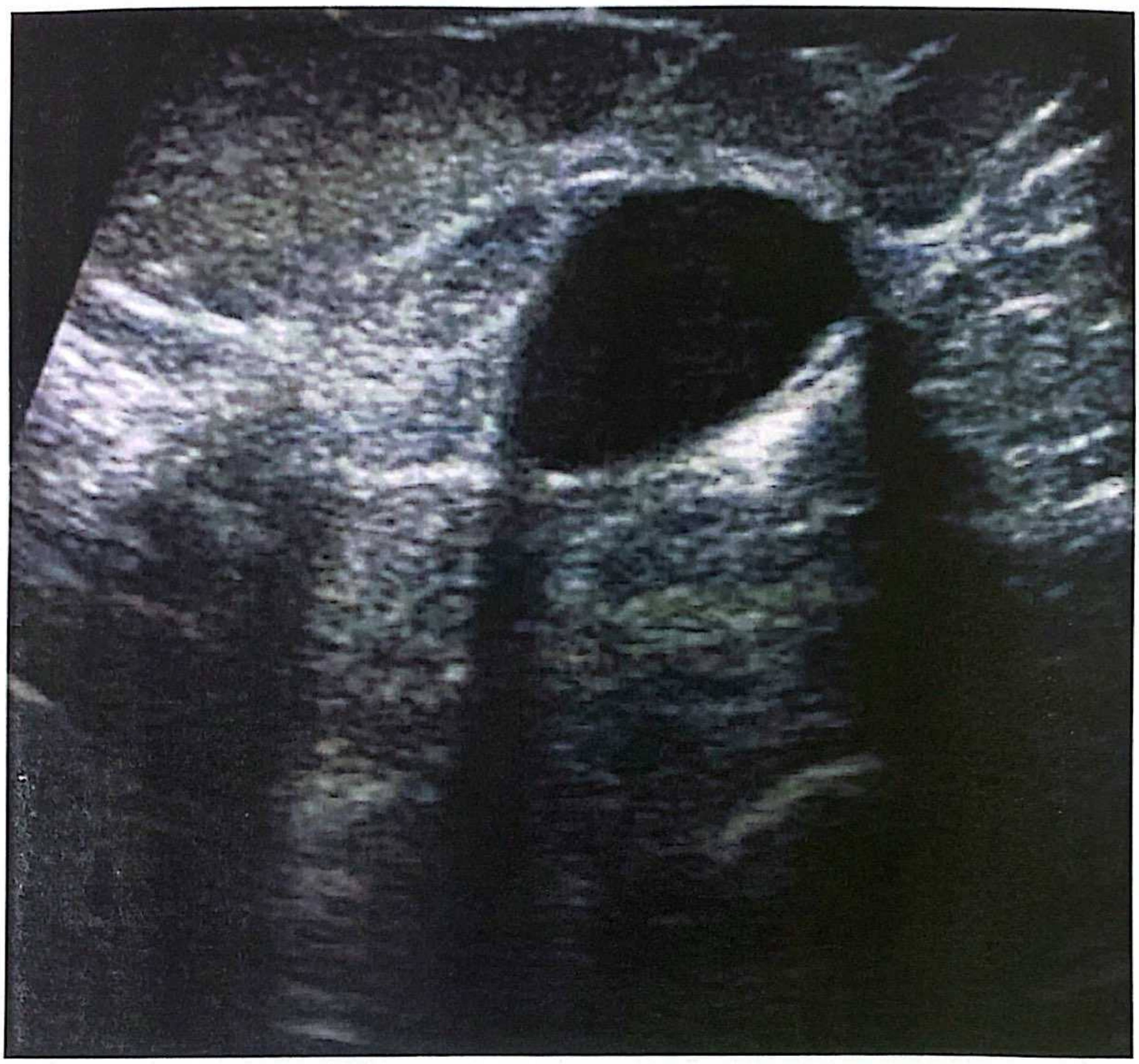
Describe: Well-circumscribed, round to ovoid, or macro lobulated mass with uniform hypo echogenicity and long axis parallel to chest wall with echogenic halo-pseudo capsule with posterior acoustic enhancement. There is increased length to depth ratio (wider then taller lesion). There is small focal contour bulge seen-hump and dip sign. No micro/Macro calcifications seen.

Diagnosis: Fibroadenoma Breast

What next: Counsel Patient. It is a benign entity and there no increased risk of malignancy however screening follow-up

BIRADS: Category 2 Benign Lesion

Q.3) Young Female **(2016)**



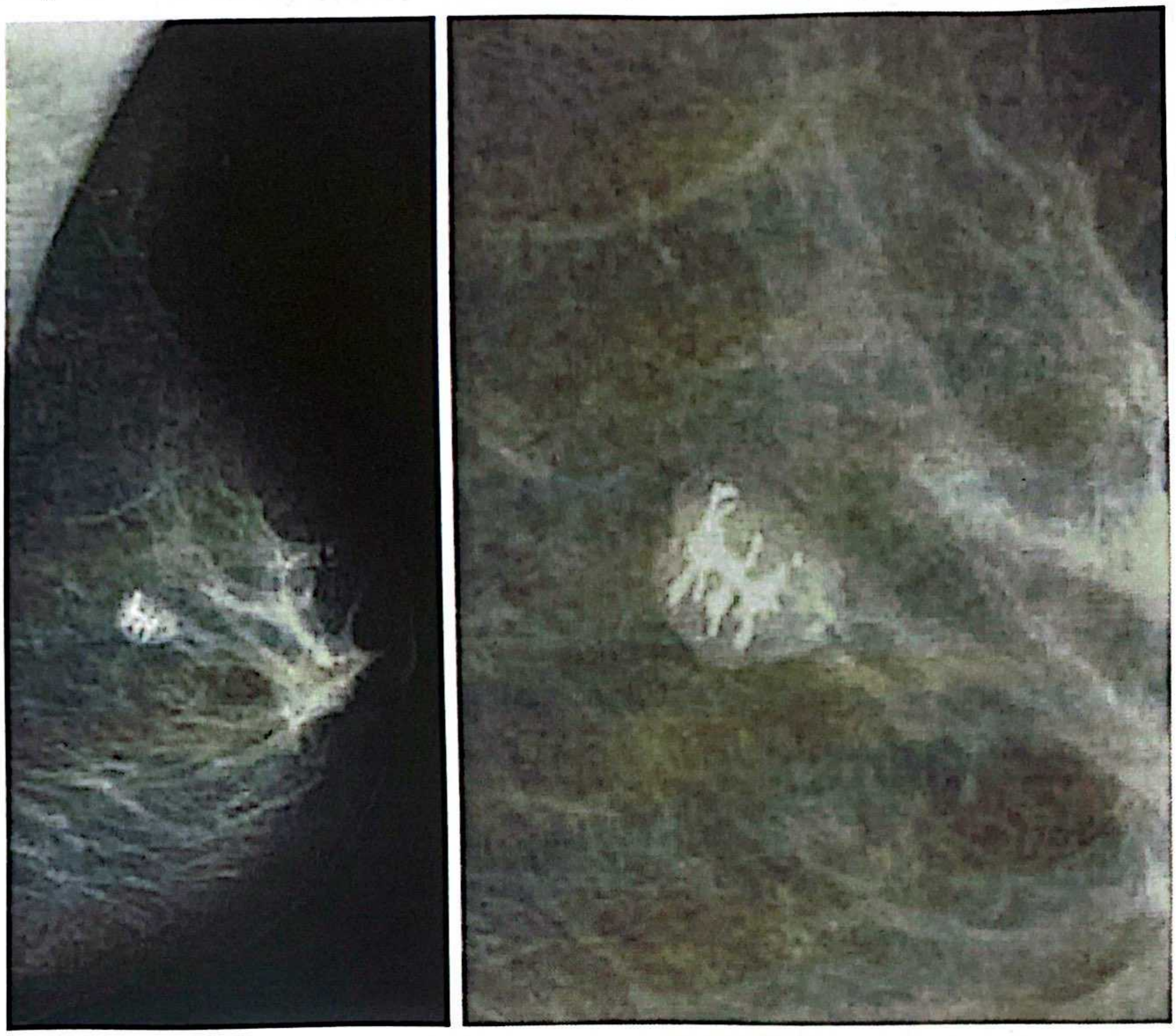
Identify: Greyscale ultrasound right breast transverse view

Describe: Well-circumscribed, round to ovoid, or macro lobulated mass with uniform hypo echogenicity and long axis parallel to chest wall with echogenic halo-pseudo capsule with posterior acoustic enhancement. There is increased length to depth ratio (wider then taller lesion). There is small focal contour bulge seen-hump and dip sign. No micro/Macro calcifications seen.

Diagnosis: BIRADS Category 2 Benign Lesion

What next: Counsel patient, It is a benign entity and there no increased risk of malignancy however screening follow-up

Q.4) Screening of 54y-Female (2015)



Identify: Mammogram Breast Mediolateral oblique view & Magnification view

Describe: Circumscribed oval mass with a bizarre macrocalcification, which is like a fish bone or "popcorn" type along with a halo sign.

Diagnosis: Fibroadenoma Breast

What next: Counsel patient, It is a benign entity and there no increased risk of malignancy but usual screening follow up is suggested

BIRADS: Category 2 benign Lesion

Indications for biopsy include:

- enlarging lesion
- atypical findings on ultrasound
- a lesion above 2.5 cm and there are no previous studies for comparison

- patient peace of mind: some patients are simply not happy with a palpable mass in the breast without a histological diagnosis; this is a valid and reasonable indication for biopsy

MR:

TIWI:

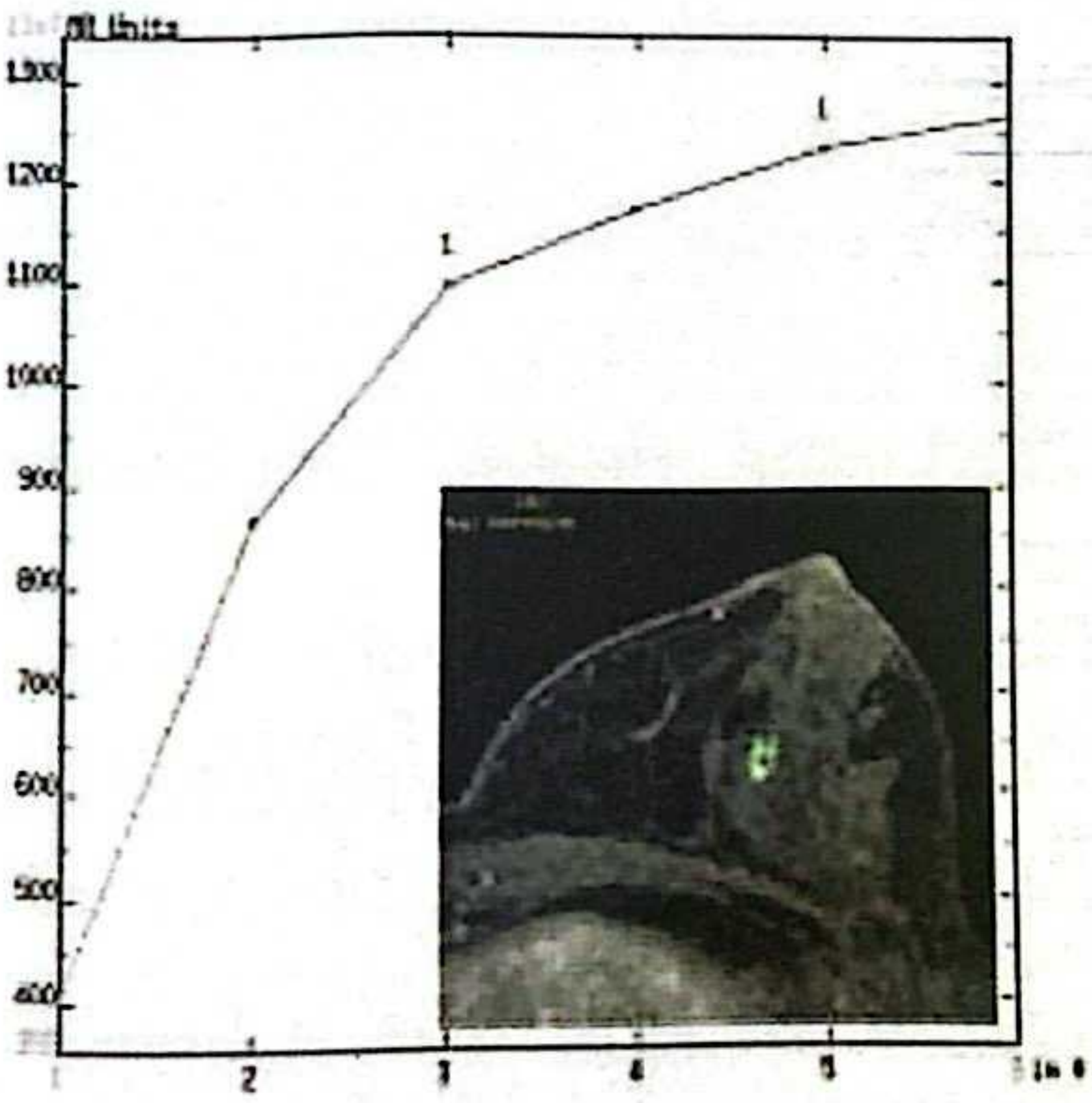
- **iso/mildly hypointense compared to parenchyma more obvious in fatty tissue endotumoral signal loss due to macrocalcifications**

Enhanced TIWI:

- **very strong enhancement** (with proportionately larger epithelial component) postinitial continuous increase I plateau endotumoral septa with mild contrast uptake

T2WI:

- high signal intensity (for tumor with proportionately larger epithelial component) in 50%
- occasionally endotumoral septations (caused by fibrotic component)
- iso/slightly hypointense compared to breast parenchyma (for predominantly fibrotic tumor) in 50%



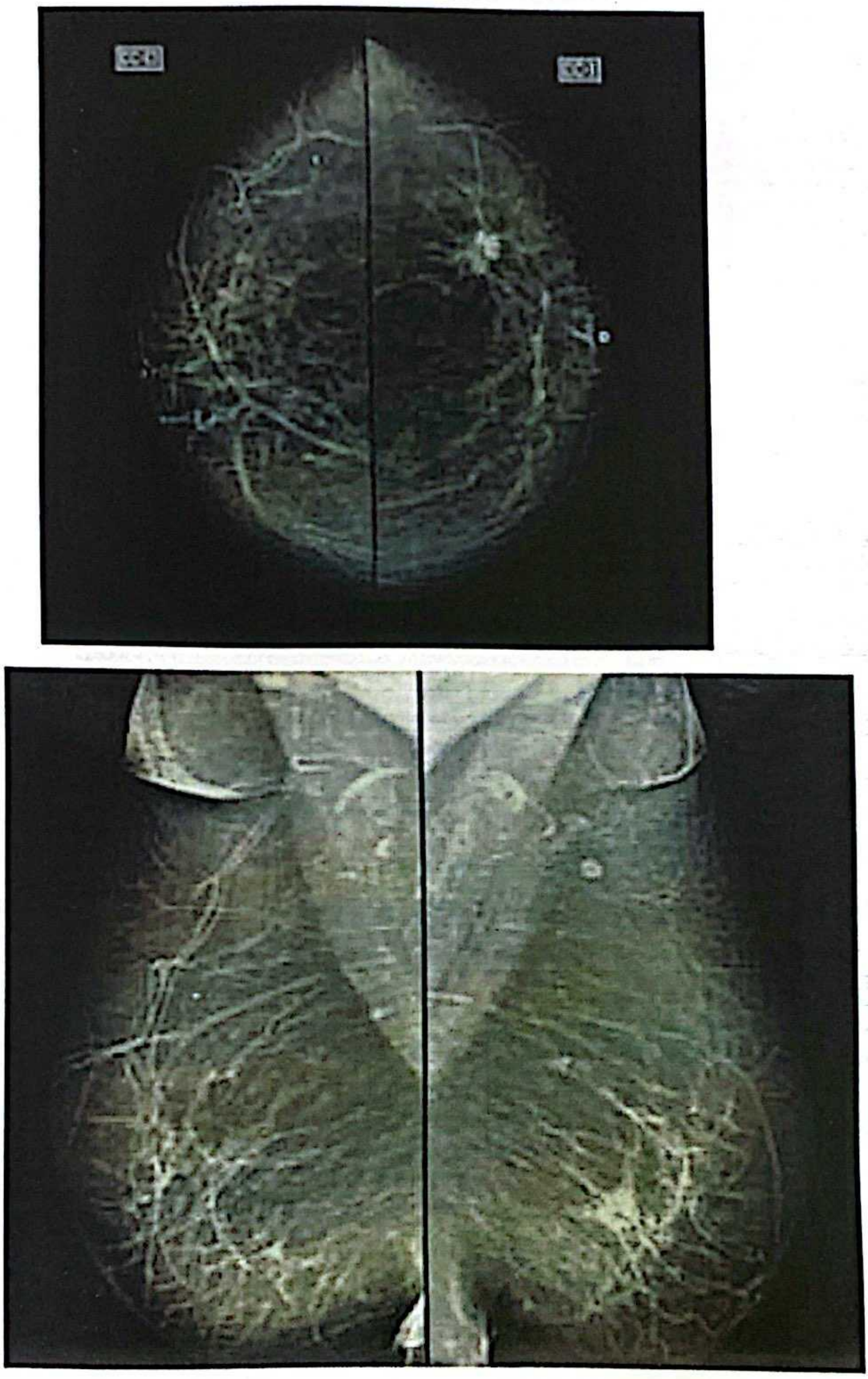
MR Perfusion

Dynamic contrast-enhanced breast MRI (MR mammography) - 1 native / 5 successive post-contrast sequences. Temporal resolution 60s.

MRI showed several features of a benign lesion: Sharp margins, lobulation/septation, centrifugal enhancement, gradual enhancement over time, and hyperintense T2 signal. Excisional biopsy yielded a fibroadenoma.

Q.5) Last mammography 4 years before-60 years-Female

(2017)



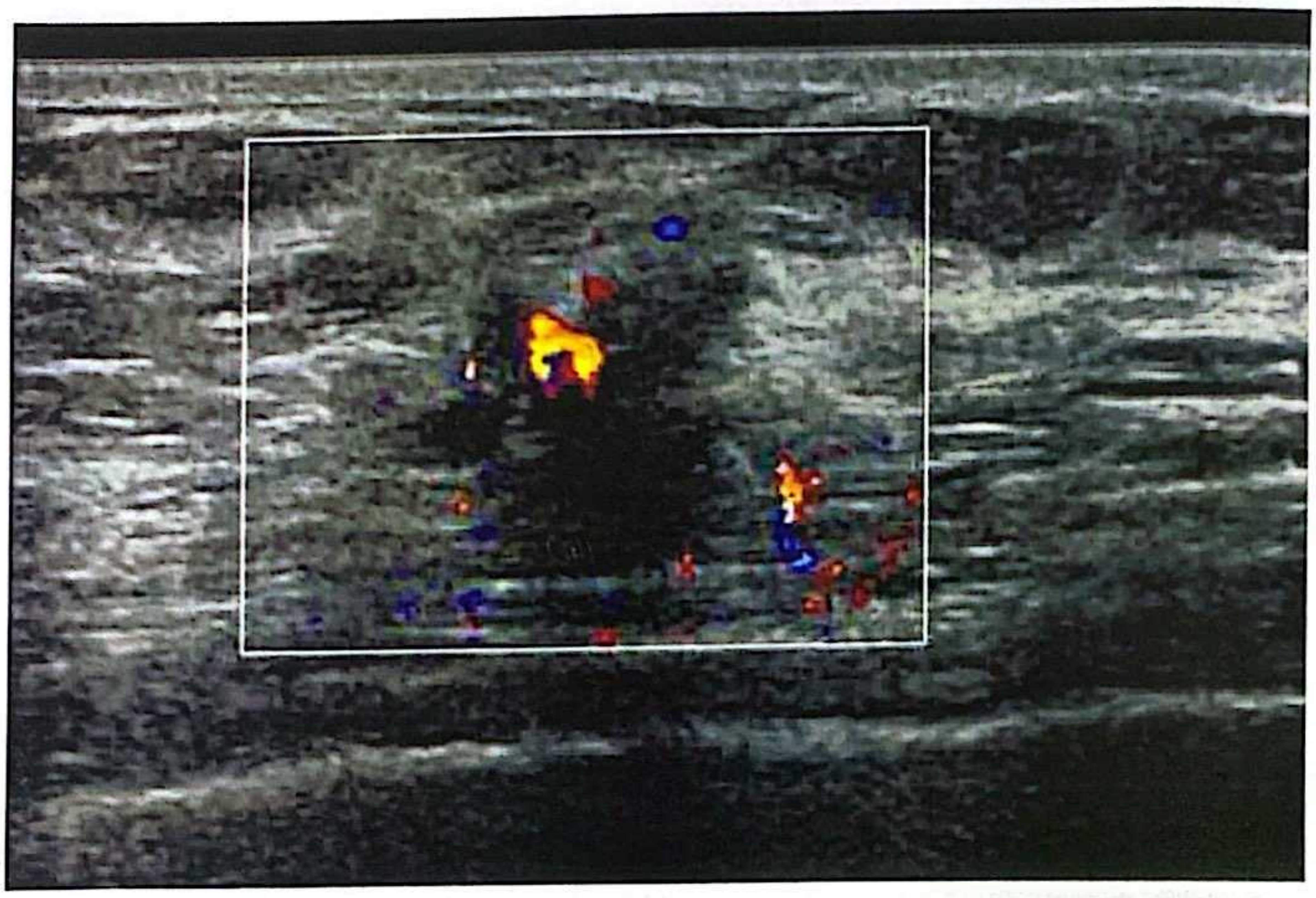
Identify: Mammogram Breast Craniocaudal view & Mediolateral oblique view

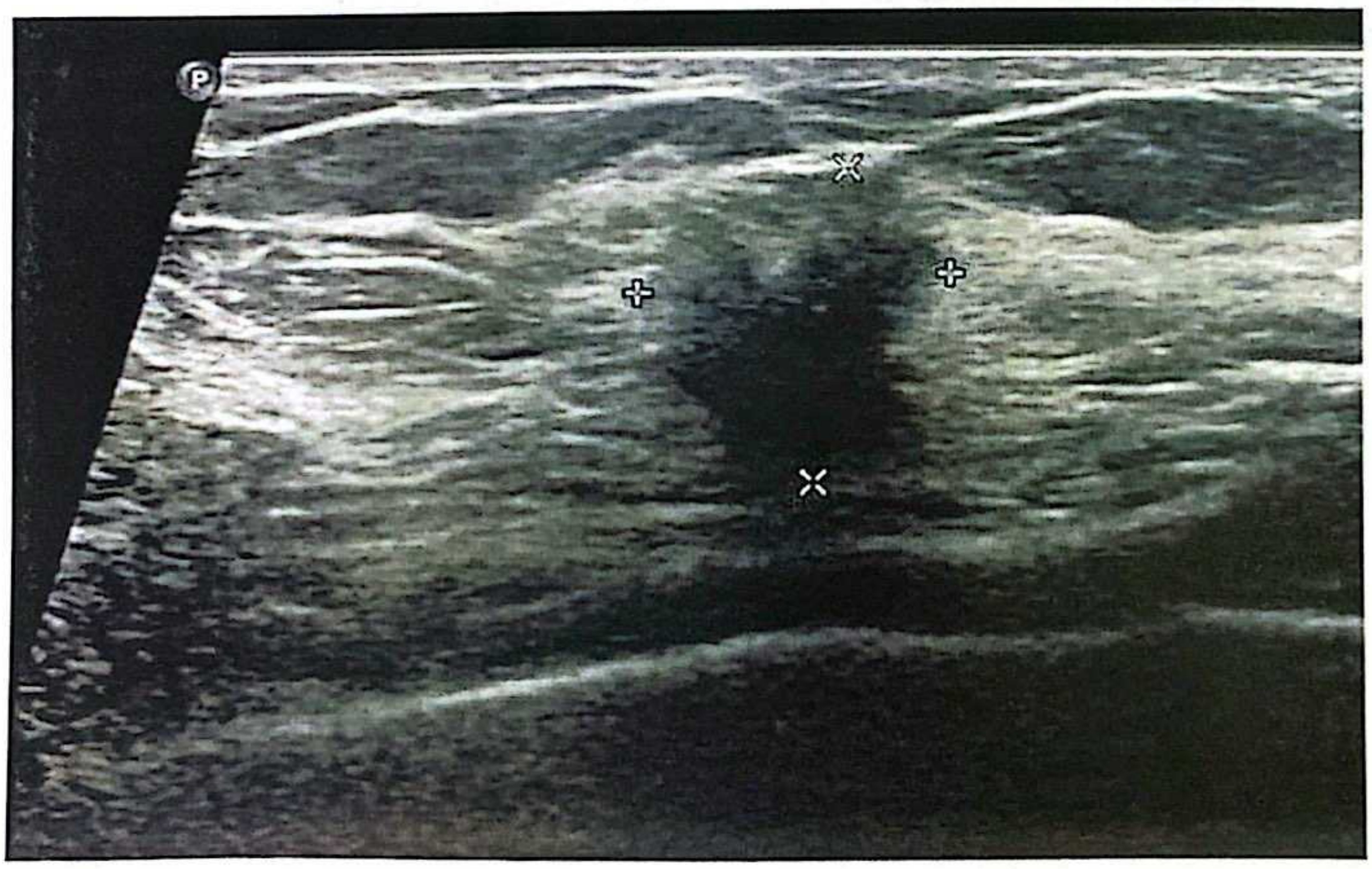
Describe: Mammogram demonstrates a dense (with central hypodensity in respect to surrounding fat), spiculated mass located at lower outer quadrant with angular margins. Few linear/segmental calcifications seen. The lesion is taller than wider. It is showing branching pattern which are extending away from nipple.

Diagnosis: BIRADS 5 Category lesion

What next: Counsel patient, Biopsy & further management in consultation with surgeon

Q.6) Last mammography 5 years before-61 years-Female (2015)





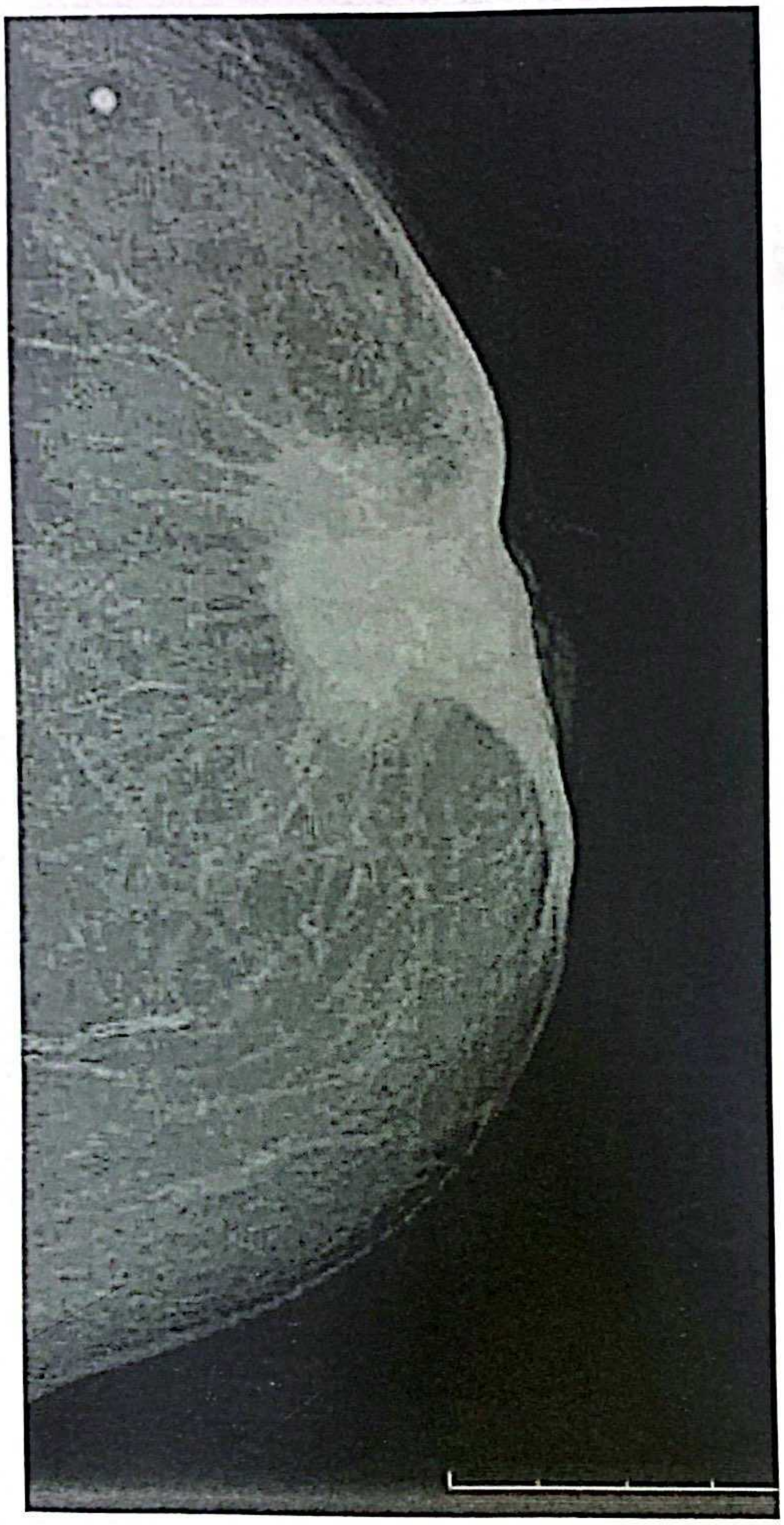
Identify: Greyscale & Colour Doppler ultrasound breast transverse view

Describe: Irregular, spiculated (straight lines radiating perpendicularly from surface of tumor), hypoechoic mass that is taller than wider with posterior shadowing and angular margins. Highly vascular at color Doppler

Diagnosis: BIRADS 5 Category lesion

What next: Counsel patient, Mammography, Biopsy & further management in consultation with surgeon

Q.7) Last mammography 5 years before-61 years-Female
(2013)



Identify: Mammogram Breast Craniocaudal view
Describe: An irregular high-density lesion with spiculated margins is seen in the retroareolar region, with associated architectural distortion and nipple retraction. Clustered microcalcifications are noted within the lesion. The lesion is taller than wider. It is showing branching pattern which are extending away from nipple.
Diagnosis: BIRADS 5 Category lesion
What next: Counsel patient, Biopsy & further management in consultation with surgeon

Mammogram

A BIRADS V lesion has the typical imaging features of breast malignancy. On mammogram, any two of the following features are demonstrated:

- spiculated or irregular mass
- high density
- fine linear or linear branching segmental calcifications
- Nipple retraction, skin thickening and evidence of interval growth, if present, would support the diagnosis.

Ultrasound

- ill-defined lesion
- hypoechoic mass
- hyperechoic angular margins
- posterior acoustic shadowing
- ductal extension may be seen which is extension of the lesion into surrounding parenchyma
- branched or spiculated pattern
- microcalcifications

MRI

T1

- isointense to parenchyma
- hypointense to fat

T1 C+ (Gd)

- ring enhacement with centripetal progression
- dilated veins draining the tumour

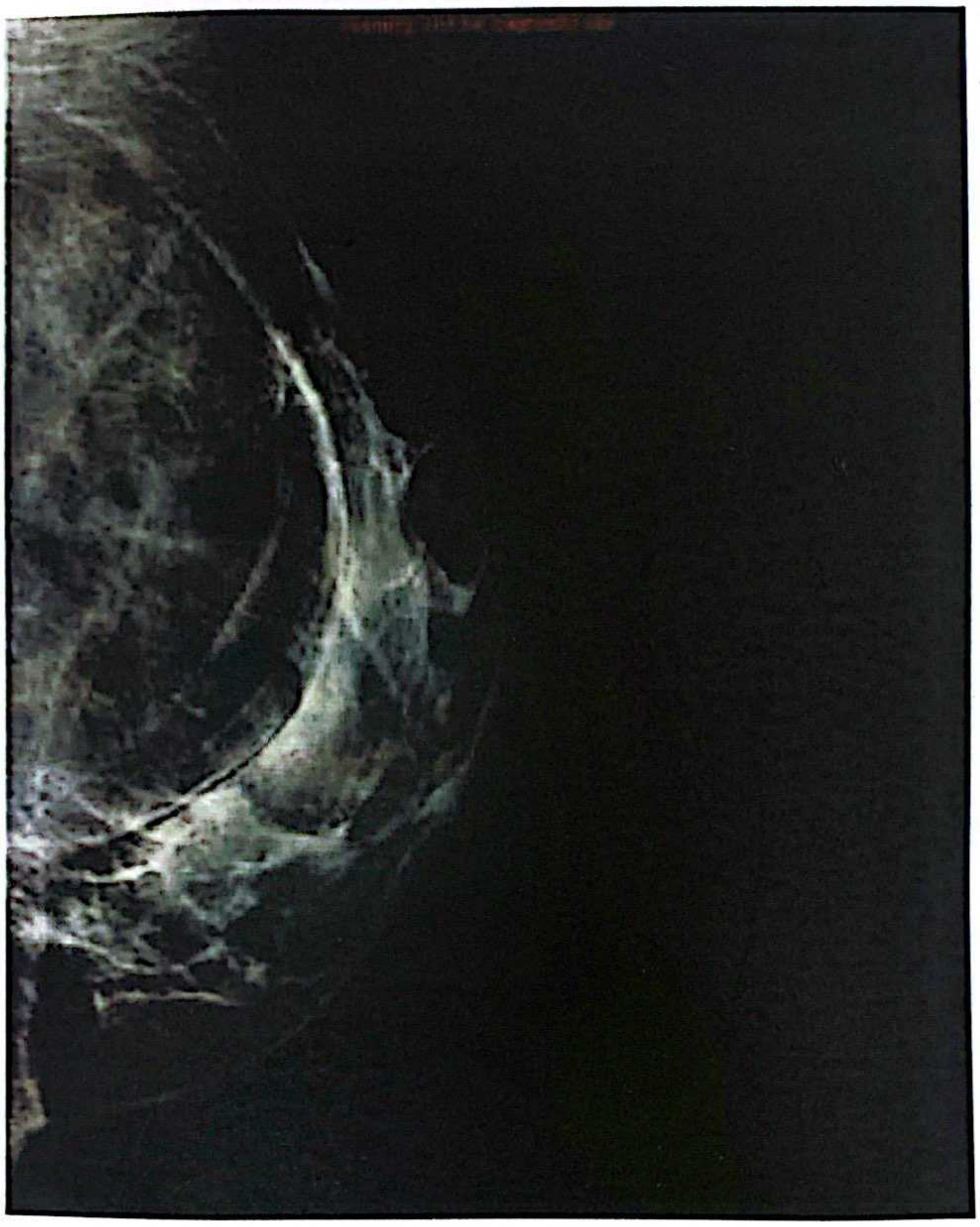
T2

- iso to hypointense to parenchyma
- hyperintense oedematous zone

BIRADS V lesions under the BIRADS (breast imaging reporting and data system) refer to breast lesions that are highly suspicious for malignancy, requiring appropriate action to be taken (i.e. biopsy and management as appropriate). BIRADS V lesions have the characteristic morphology of breast cancer with a >95% chance of being malignant.

Q.8) Mobile left breast lump-AGE:35-Female

(2016)



Identify: Mammogram Breast Craniocaudal view

Describe: Radiolucent mass with no calcification in retromammary zone. Compressing adjacent parenchyma. Multiple thin echogenic sepations seen running parallel to the skin surface

Thin, peripheral high-density capsule.

No skin thickening, nipple retraction, lymphadenopathy.

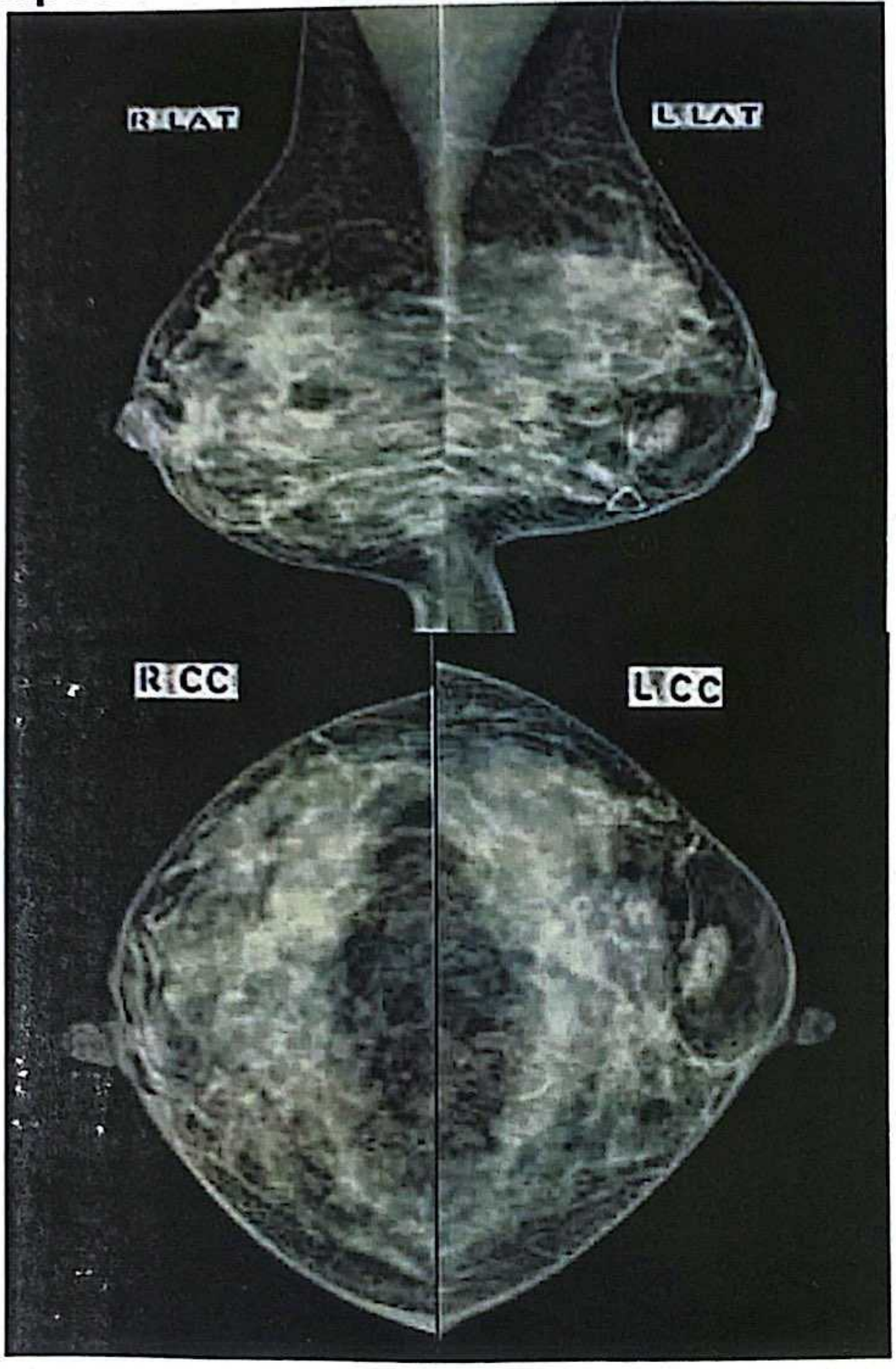
Diagnosis: Breast Lipoma

BIRADS: Category 2 Benign Lesion

What next:

- MLO view
- Contralateral mammogram
- Ultrasound breast
- Reassure/Counsel patient

Q.9) Palpable left breast mass-AGE: 35-GENDER: Female (2015)



Identify: Mammogram Breast Craniocaudal view & Mediolateral oblique view

Describe: Lower outer quadrant left breast (partially behind the nipple) shows a well-circumscribed, round to oval inhomogeneous mass surrounded by a thin capsule and contains fat and breast parenchyma with both radiolucent and radiodense components- "breast within a breast" or a "slice of sausage" appearance.

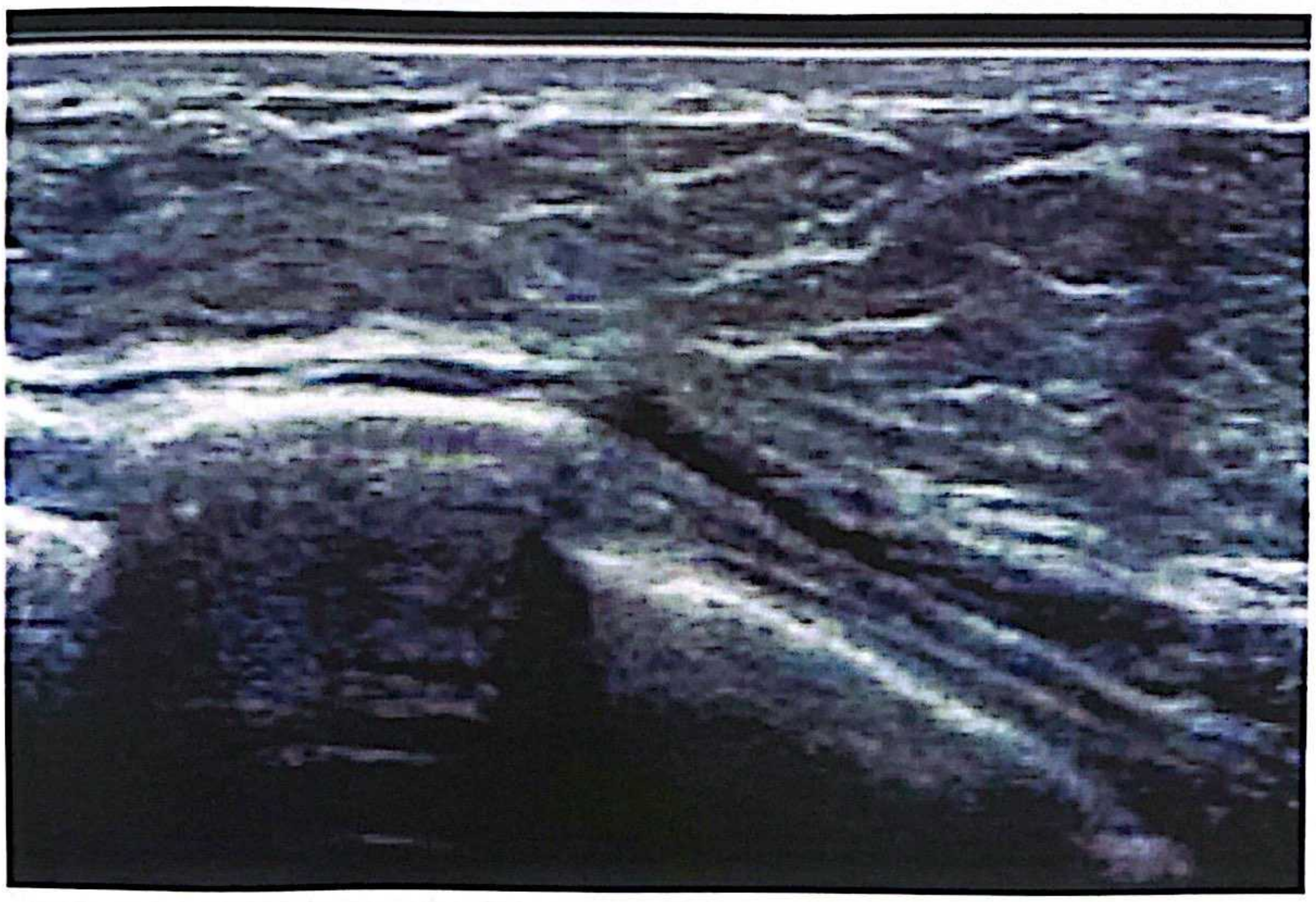
Diagnosis: Hamartoma/Adenolipoma of breast

What next: Counsel patient

Differential Diagnosis:

- Adenolipoma
- Galactocoele
- Hematoma
- Lymph nodes

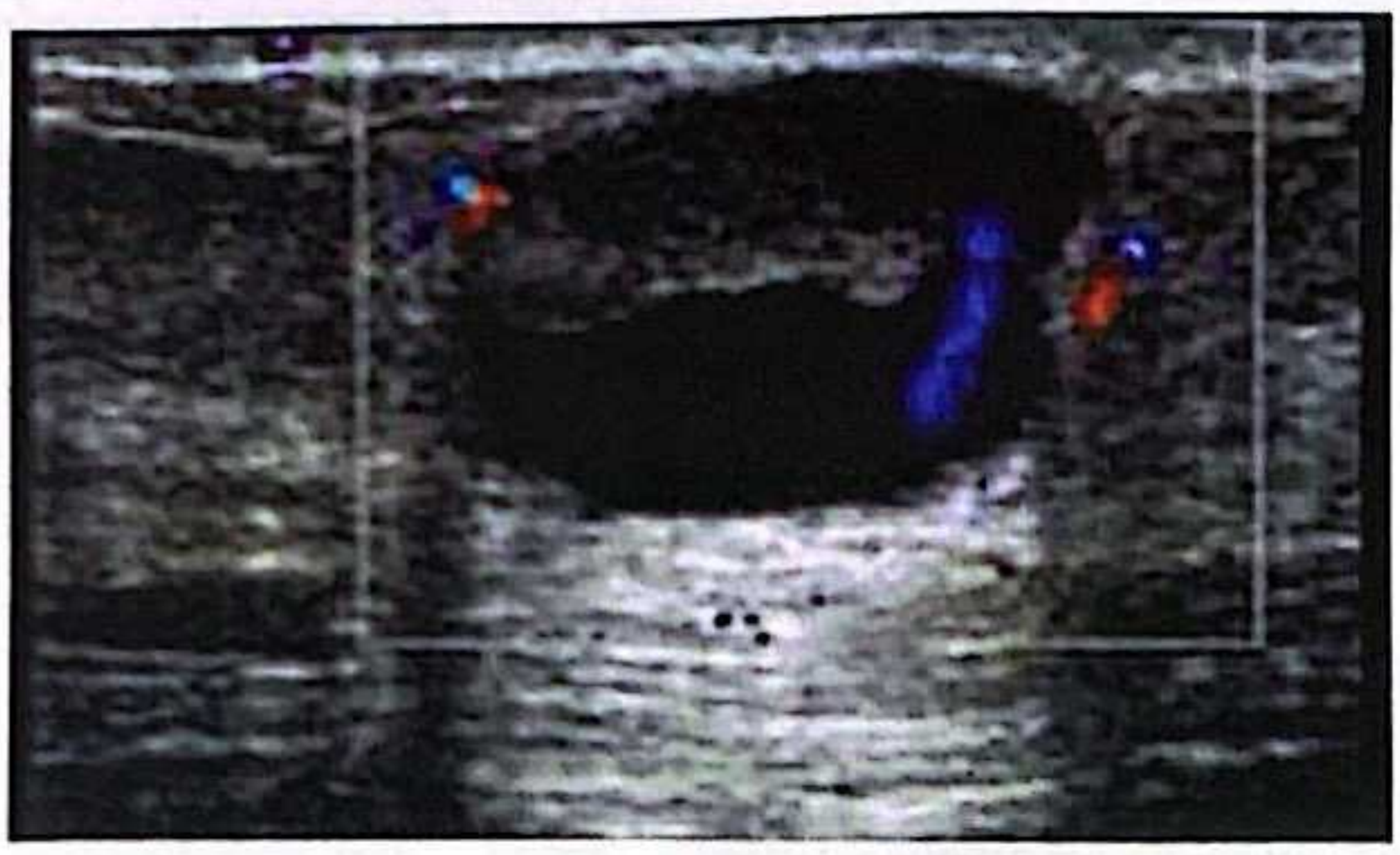
Q.10) Palpable left breast mass-AGE: 35-GENDER: Female



Identify: Greyscale ultrasound right breast transverse view
Describe: Behind the left nipple is a mass with a thin capsule that has an echotexture similar to normal breast parenchyma.
it is difficult to delineate the margins. A well-circumscribed, solid lesion without any intralesional microcalcification. Internal echotexture most often mixed with both hyperechoic and hypoechoic components. Lesion is looking compressed with adjacent parenchyma.
Diagnosis: Hamartoma/Adenolipoma of breast
What next: Mammography, Counsel patient
Differential Diagnosis:

- Adenolipoma
- Galactocoele
- Hematoma
- Lymph nodes

Q.11) **(2014)**



Identify: Greyscale & Colour Doppler ultrasound breast transverse view

Describe: Well defined anechoic cystic lesion with eccentric solid component with posterior acoustic shadowing. No micro/macro calcification seen however minimal peripheral vascularity is seen on color doppler.

Diagnosis: Intracystic papillary breast carcinoma

What next:

Mammography

The most common mammographic pattern of invasive papillary carcinoma is a round, oval or lobulated mass. The mass margins are usually circumscribed but may be obscured or indistinct. Accompanying microcalcifications or a dilated ductal pattern may also be present.

Galactography: ductography

For patients presenting with nipple discharge, galactography may be helpful. Like intraductal papillomas, papillary carcinomas may be evident as ductal obstruction, filling defects, or focal or diffuse ductal wall irregularity.

Breast MRI

If serous, it will have low signal intensity on T1-weighted images and high signal intensity on T2-weighted images

if there are haemorrhagic contents, it will be hyperintense on both T1- and T2-weighted images and fluid-fluid levels may be seen on T2-weighted images.

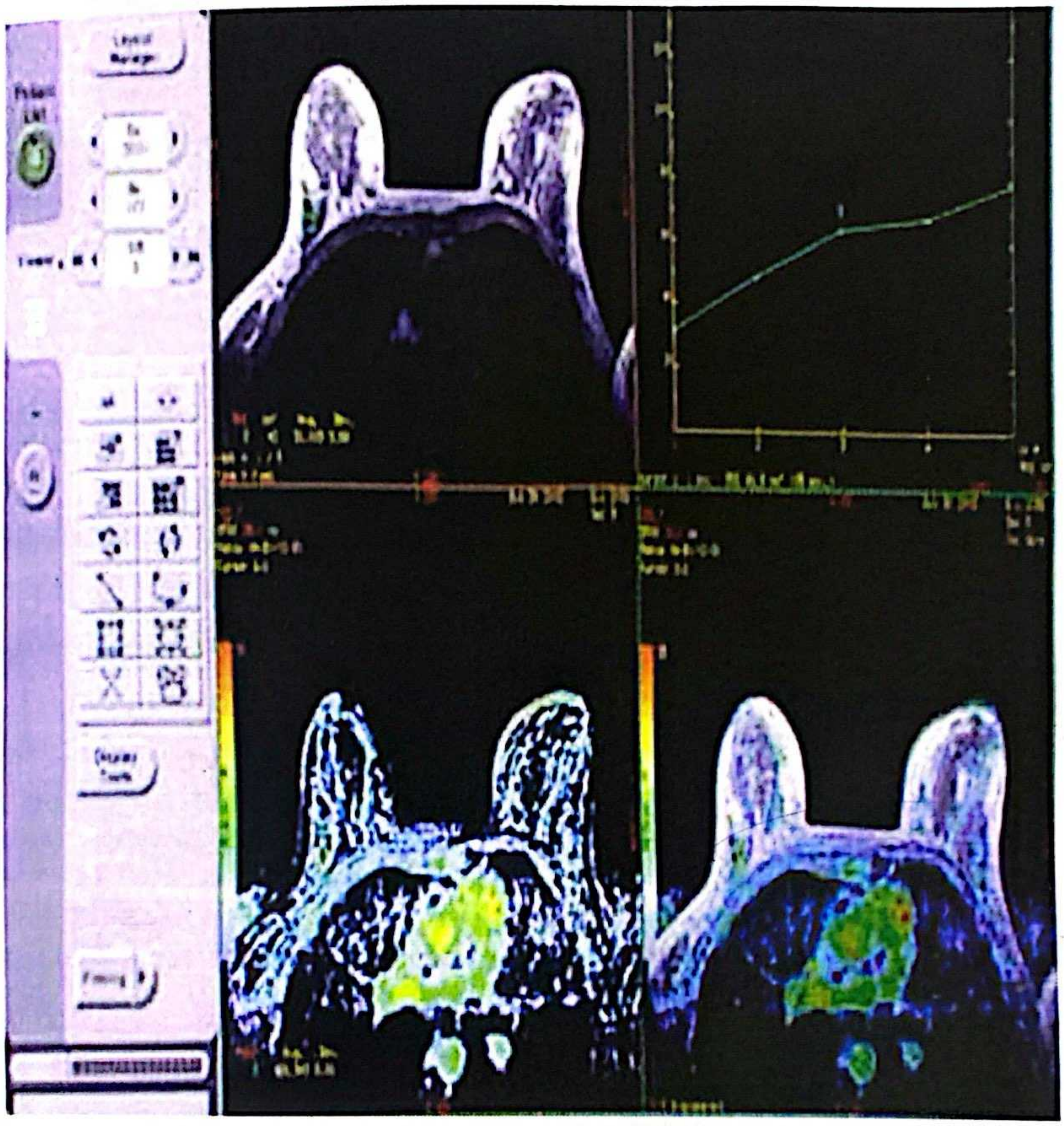
Intracystic haemorrhage is a characteristic common finding at pathologic examination of papillary carcinomas.

Contrast-enhanced MR imaging may show marked enhancement of the cyst walls, septa, and mural nodules.

Treatment and prognosis

The overall prognosis is better than for commoner types of breast malignancy such as invasive ductal carcinoma not otherwise specified (NOS).

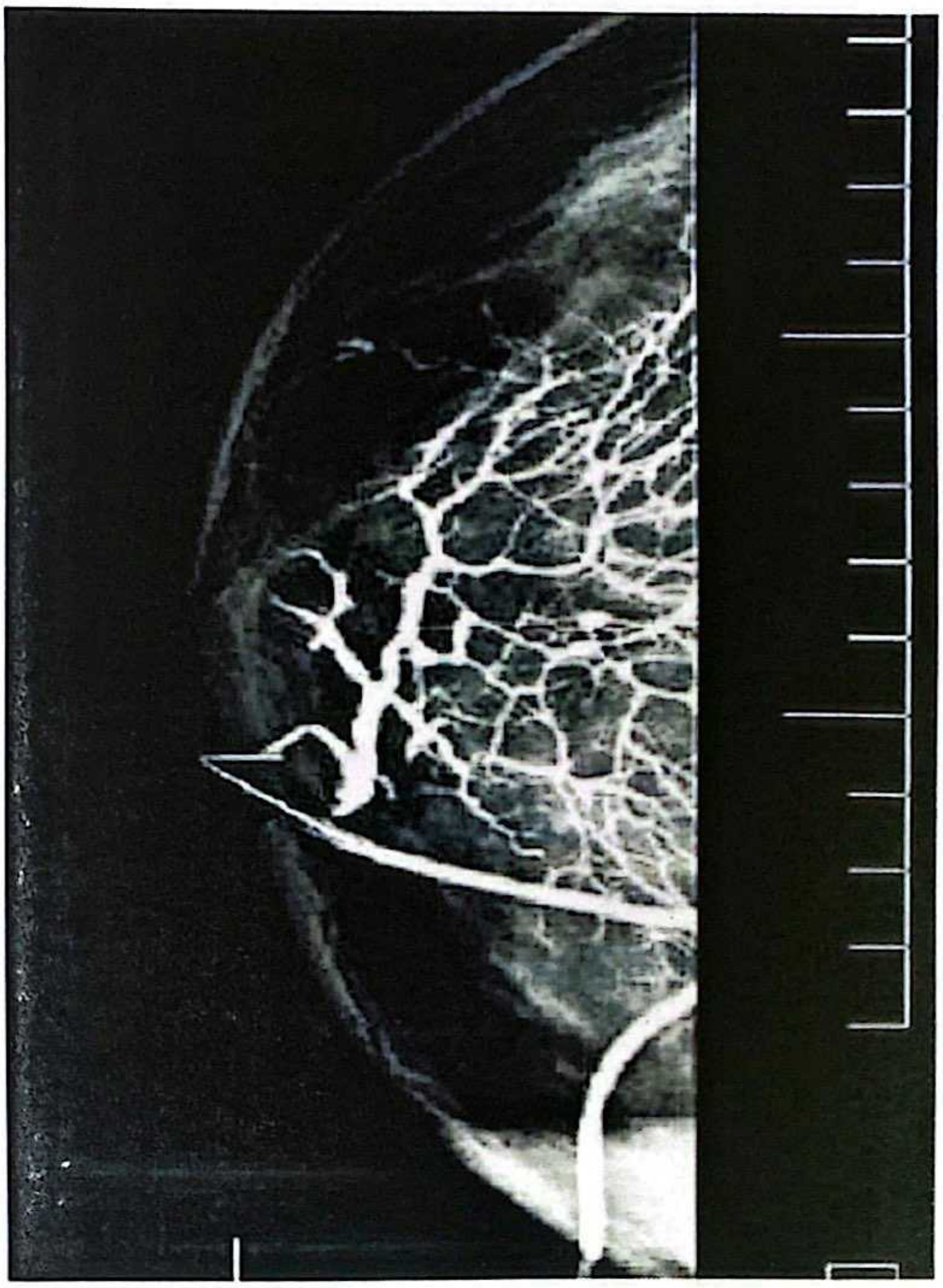
Q.12) (2016)



Identify the examination: MR MAMMOGRAM
Describe the pattern and type of curve for benign lesion
Describe the pattern and type of curve for malignant lesion

TYPE I: Slow and continued rise with time **(Benign)**
TYPE II: Slow or rapid initial rise followed by plateau in delayed phase
TYPE III: Rapid initial rise with washout in delayed phase. **(Malignant)**

Q.13) **(2016)**



Identify: Ductogram/Galctogram Ductography (Galactography) Right Breast craniocaudal projection

Views: A standard two view mammography (or craniocaudal and mediolateral projections) are obtained.

Needle used: A blunt-tipped sialogram needle (30-gauge)

Amount of contrast: 2-3ML

Type of contrast: Water soluble low osmolar contrast

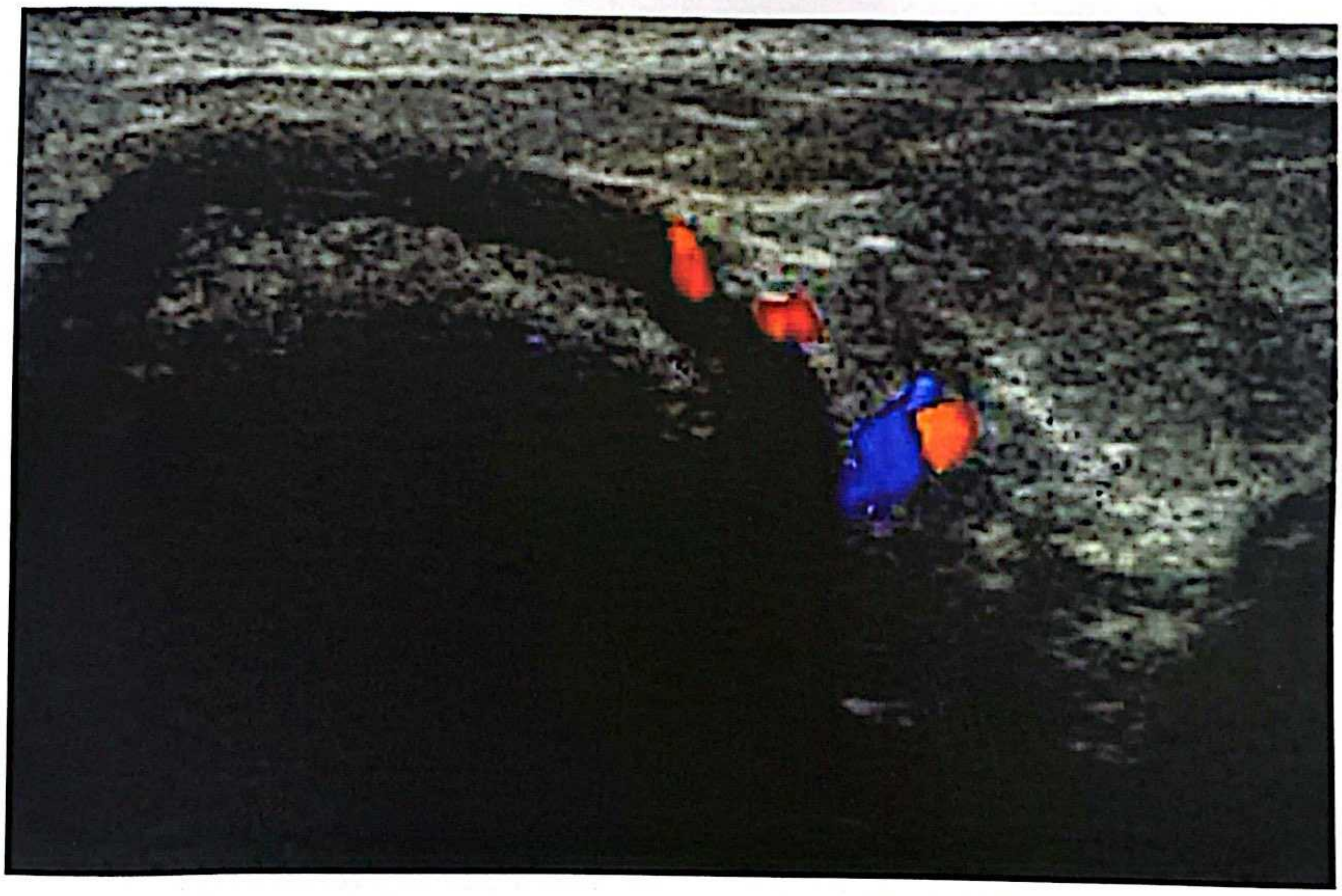
Indications:

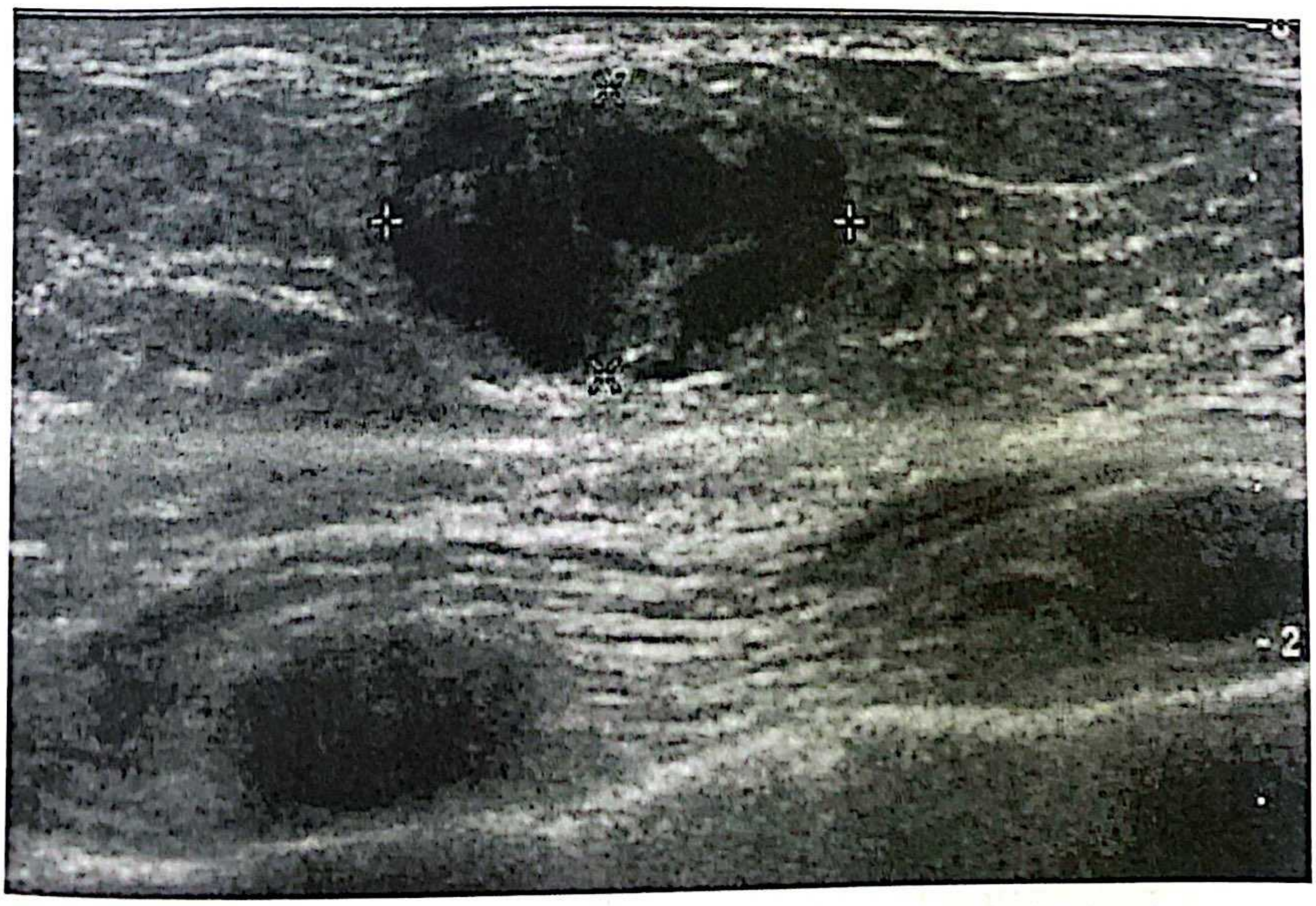
- Unilateral blood stained nipple discharge
- Intraductal papilloma
- Duct ectasia

Complications:

- Duct perforation, which may lead to extravasation of contrast into breast parenchyma
- Pain or a burning sensation
- Infection: galactography should not be performed when there is a purulent breast discharge

Q.14) Presented with a painless lump in her left breast. The lump was first diagnosed during breastfeeding Other case of glactocele with multiple cysts.





Identify: Greyscale & Colour Doppler ultrasound breast transverse view

Describe: Ultrasound shows a round mass with no internal flow. Anteriorly outlined by two curvilinear parallel lines; the external line being hypoechoic and vascularized, and the internal line is hyperechoic which produce a sharply well-defined shadow, obscuring details posterior to the mass- Wall echo shadow sign

Diagnosis: Galactocele

What next:

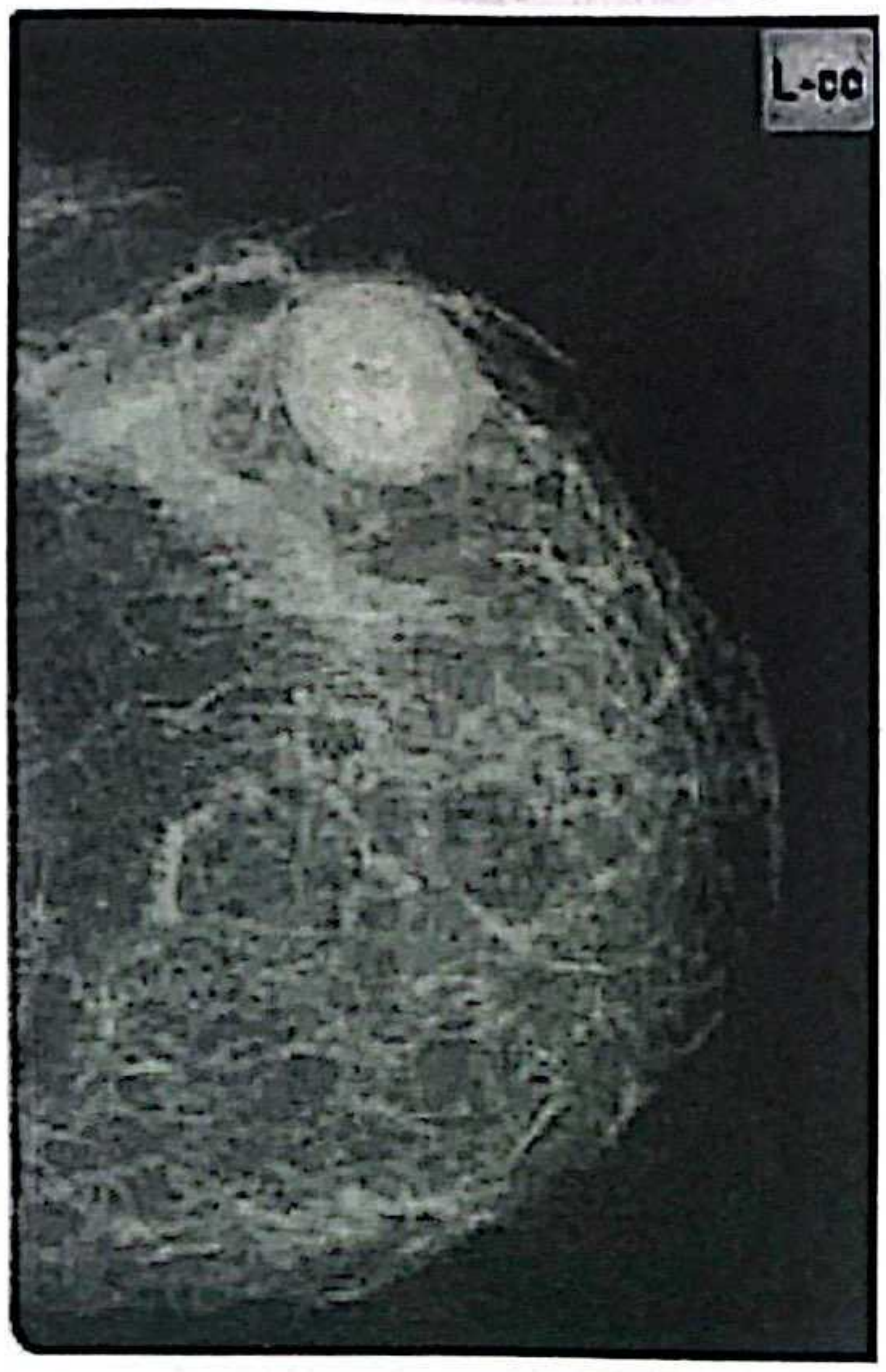
- Mammography
- FNAC
- Aspiration
- Surgical removal
- Spontaneous resolution occurs in a clear majority of cases

Differential diagnosis

- lactating adenoma: seen as a solid lesion and may show colour flow within it
- breast abscess: has a different clinical presentation, but can develop as a complication
- fibroadenoma: classically ovoid or almond shaped with smooth border, internal homogeneous echogenicity and acoustic enhancement 7
- carcinoma of the breast: especially for certain lesions on ultrasound

Q bank

Q.15) Presented with a painless lump in her left breast. The lump was first diagnosed during breastfeeding



Identify: Mammogram Breast Craniocaudal view

Describe: Mammography shows a halo sign that is a radiolucent ring surrounding a dense nodule.

Diagnosis: Galactocele

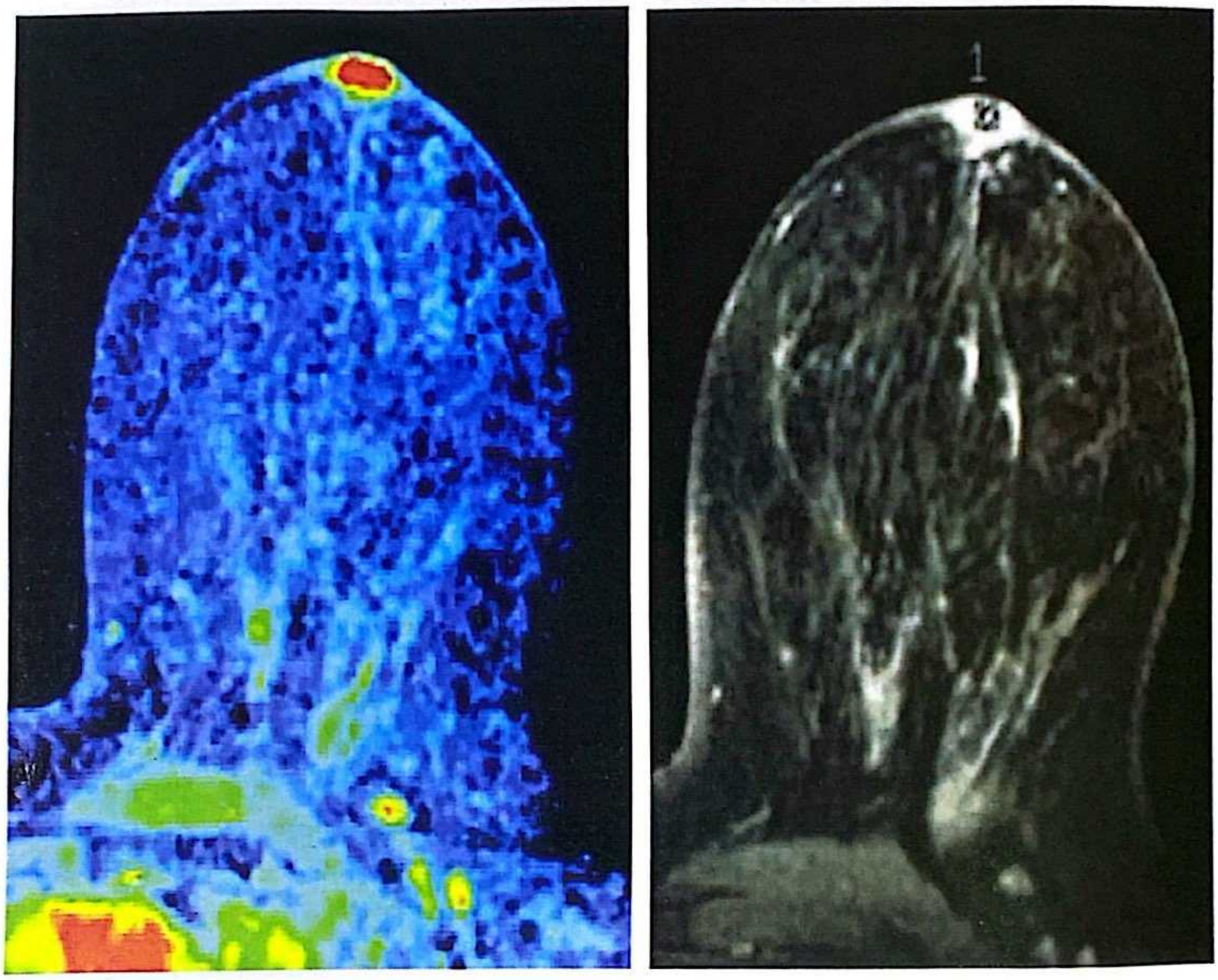
What next:

- Ultrasound
- FNAC
- Aspiration
- Surgical removal
- Spontaneous resolution occurs in a clear majority of cases

Differential diagnosis

- lactating adenoma: seen as a solid lesion and may show colour flow within it
- breast abscess: has a different clinical presentation, but can develop as a complication
- fibroadenoma: classically ovoid or almond shaped with smooth border, internal homogeneous echogenicity and acoustic enhancement 7
- carcinoma of the breast: especially for certain lesions on ultrasound

Q.16) Eczematous appearing changes of the nipple include reddening, scaling, hyperkeratosis, and crusting of the nipple surface.



Identify: Dynamic contrast-enhanced (DCE) MRI Breast

Describe: Abnormal nipple enhancement and linear clumped enhancement seen at the nipple

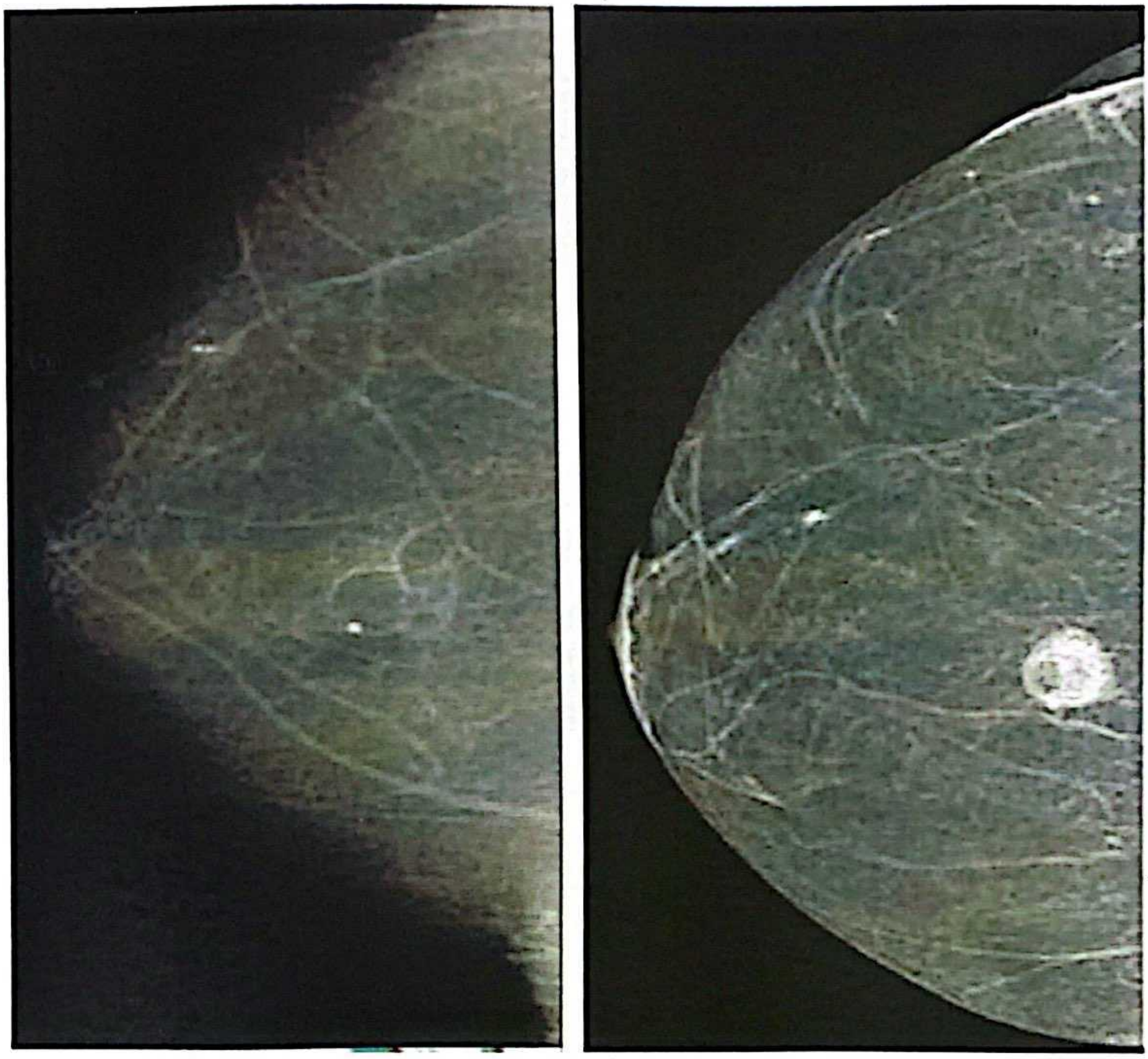
Diagnosis: Paget's Disease

What next:

Mastectomy with nodal dissection

MR, breast-conserving therapy

Q.17) 60 Years old female with a previous history of Right breast biopsy



Identify: Mammogram Breast Craniocaudal view

Describe: Radiolucent rounded mass of fat density +/- wall calcification (2^{nd} Image) which if present typically appears as eggshell calcification

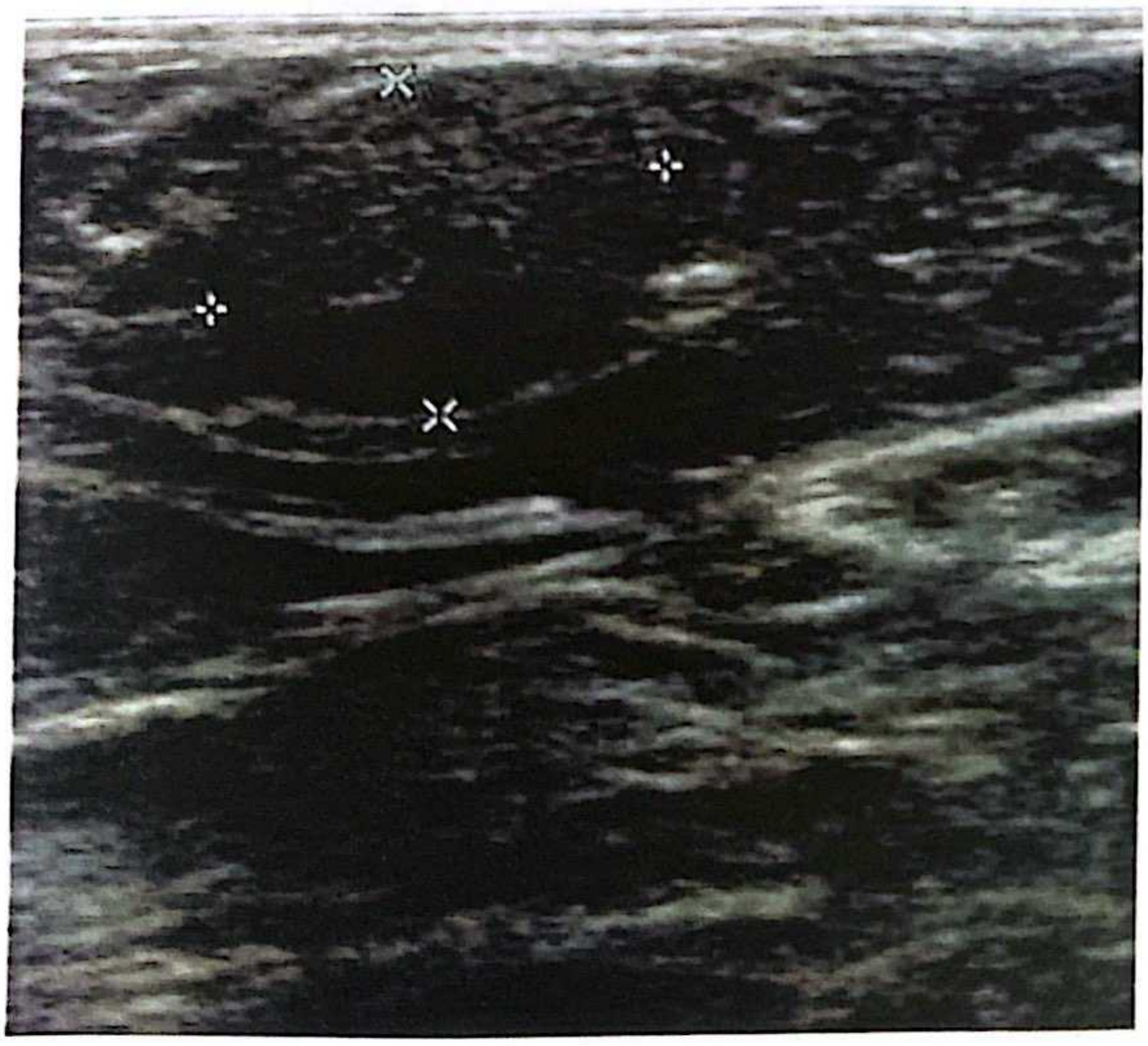
Diagnosis: Oil Cyst/Fat Necrosis

What next:

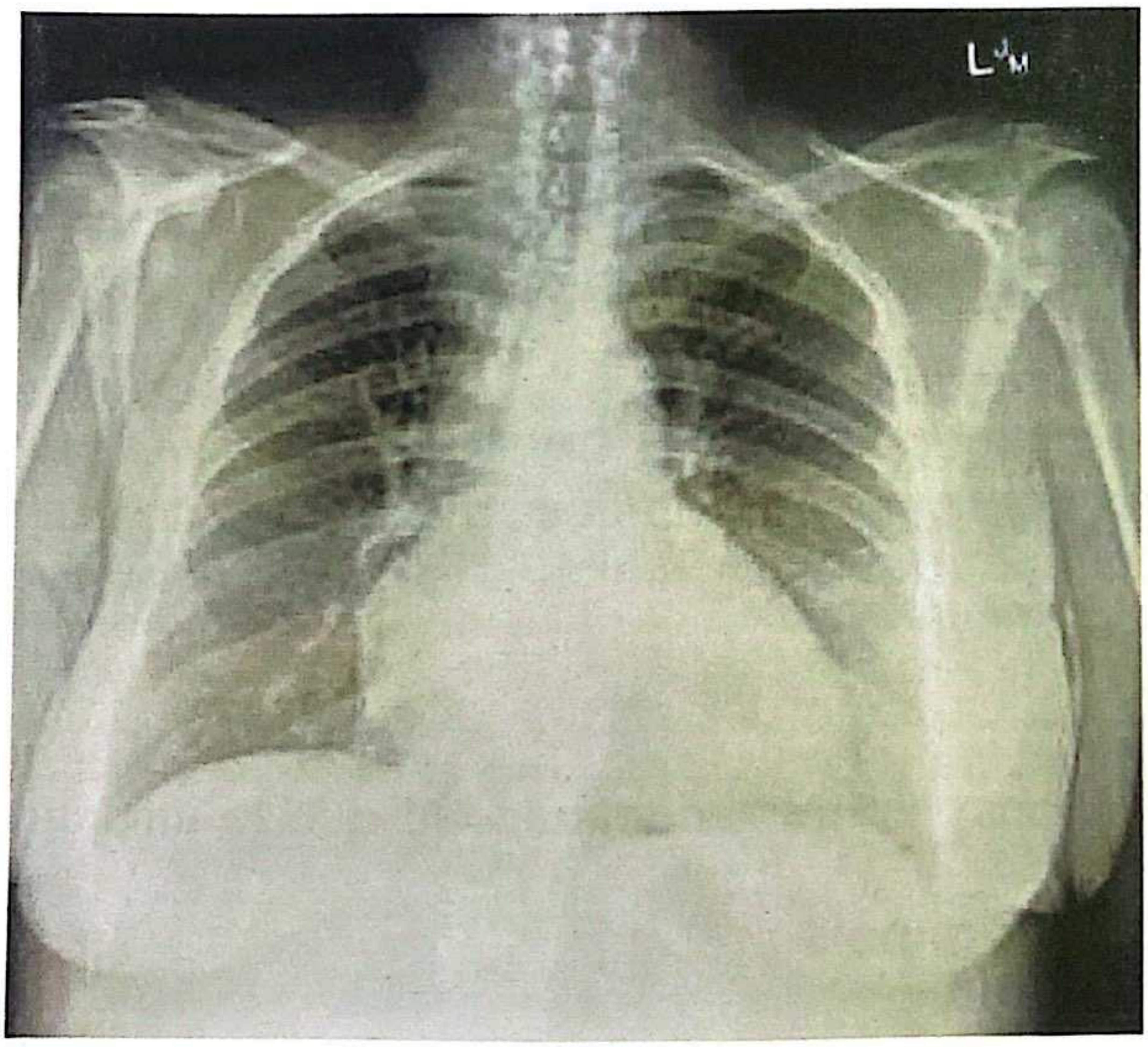
Aspiration/biopsy is not recommended due to inflammatory nature of oil contents.

Differential diagnosis

- fat necrosis
- intramammary lipoma
- on ultrasound, an oil cyst and seroma are often indistinguishable
- galactocele



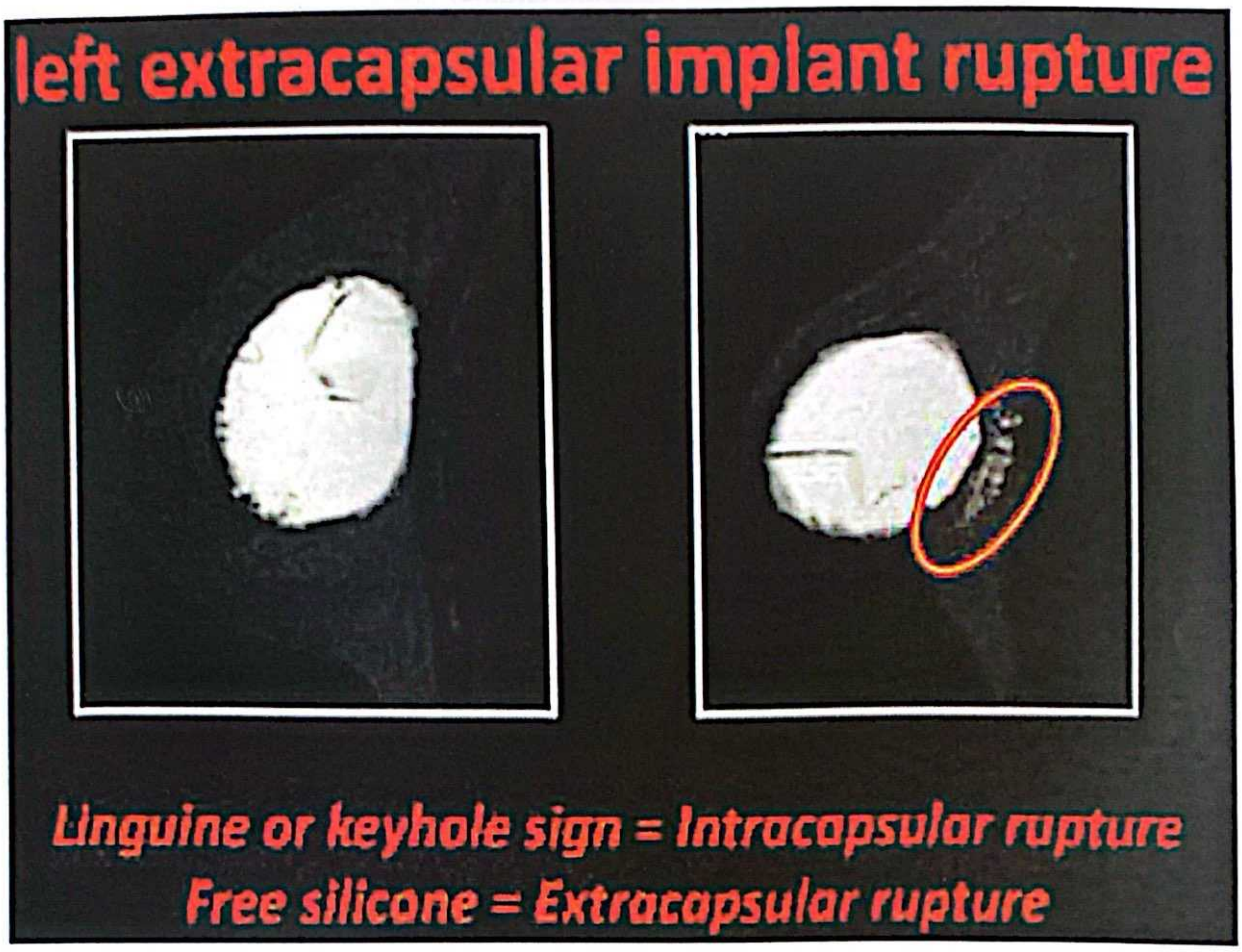
Oil Cyst



Fat Necrosis/ Oil Cyst after seat belt injury

Q.18) Silicone implants rupture

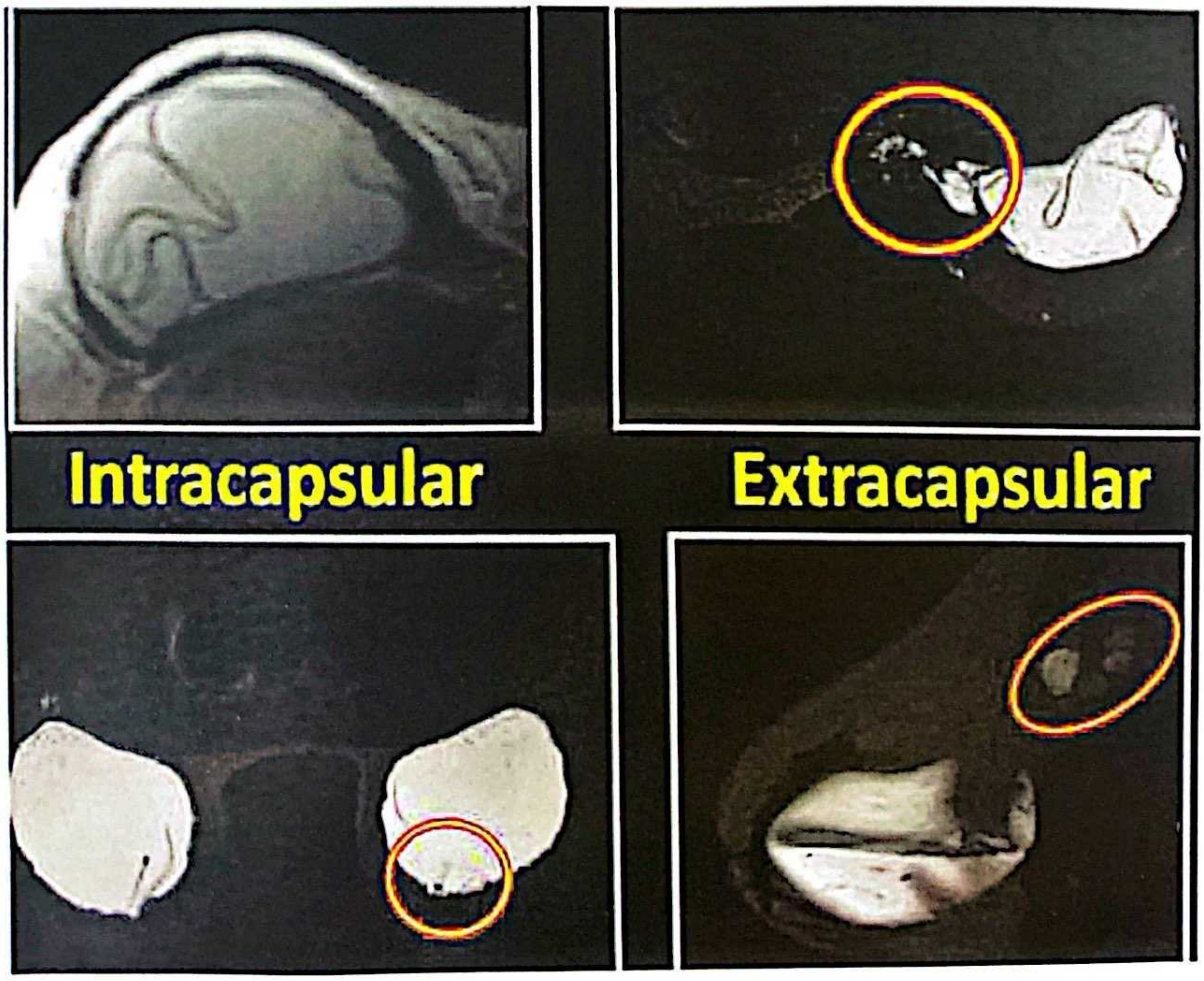
MRI



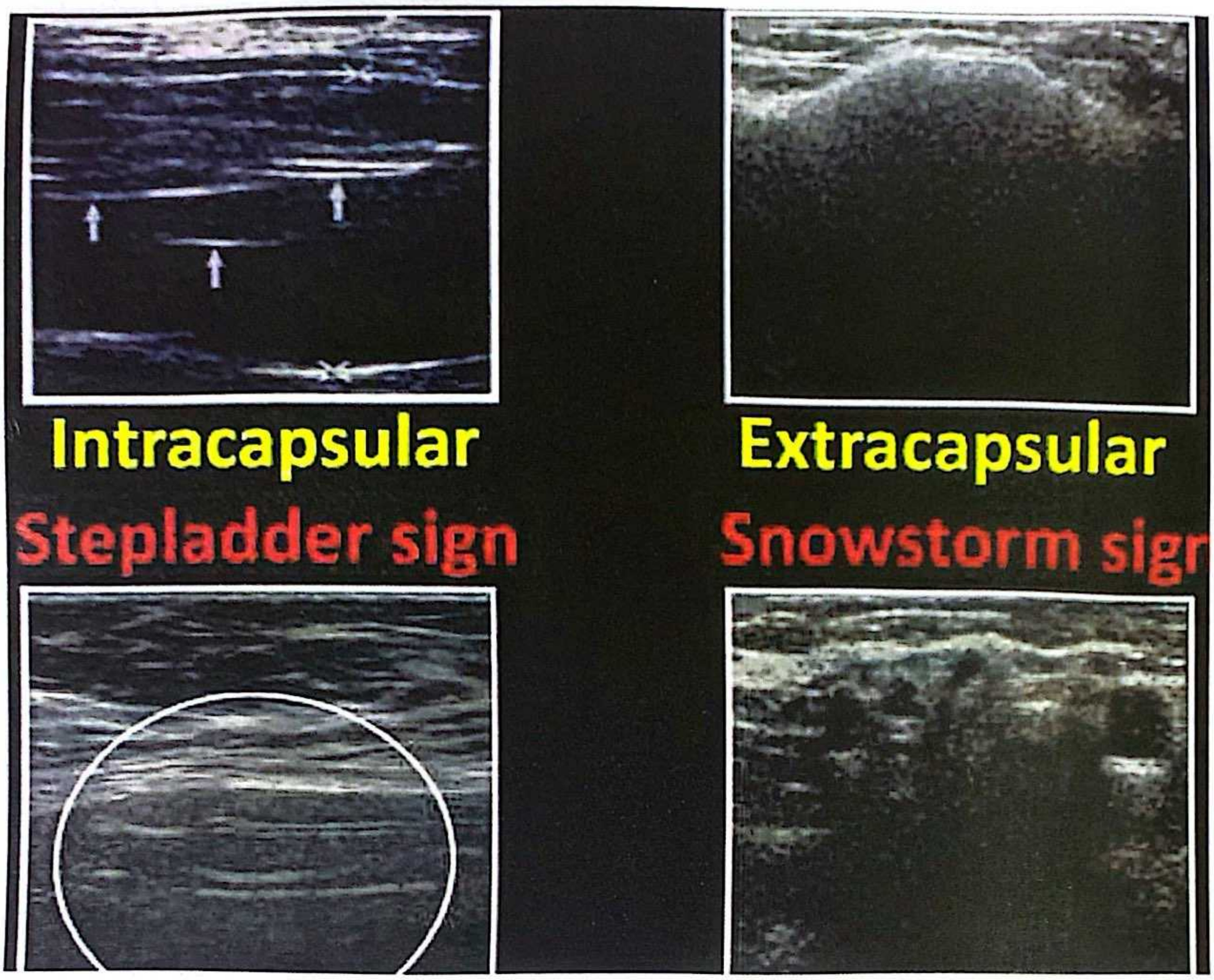
left extracapsular implant rupture

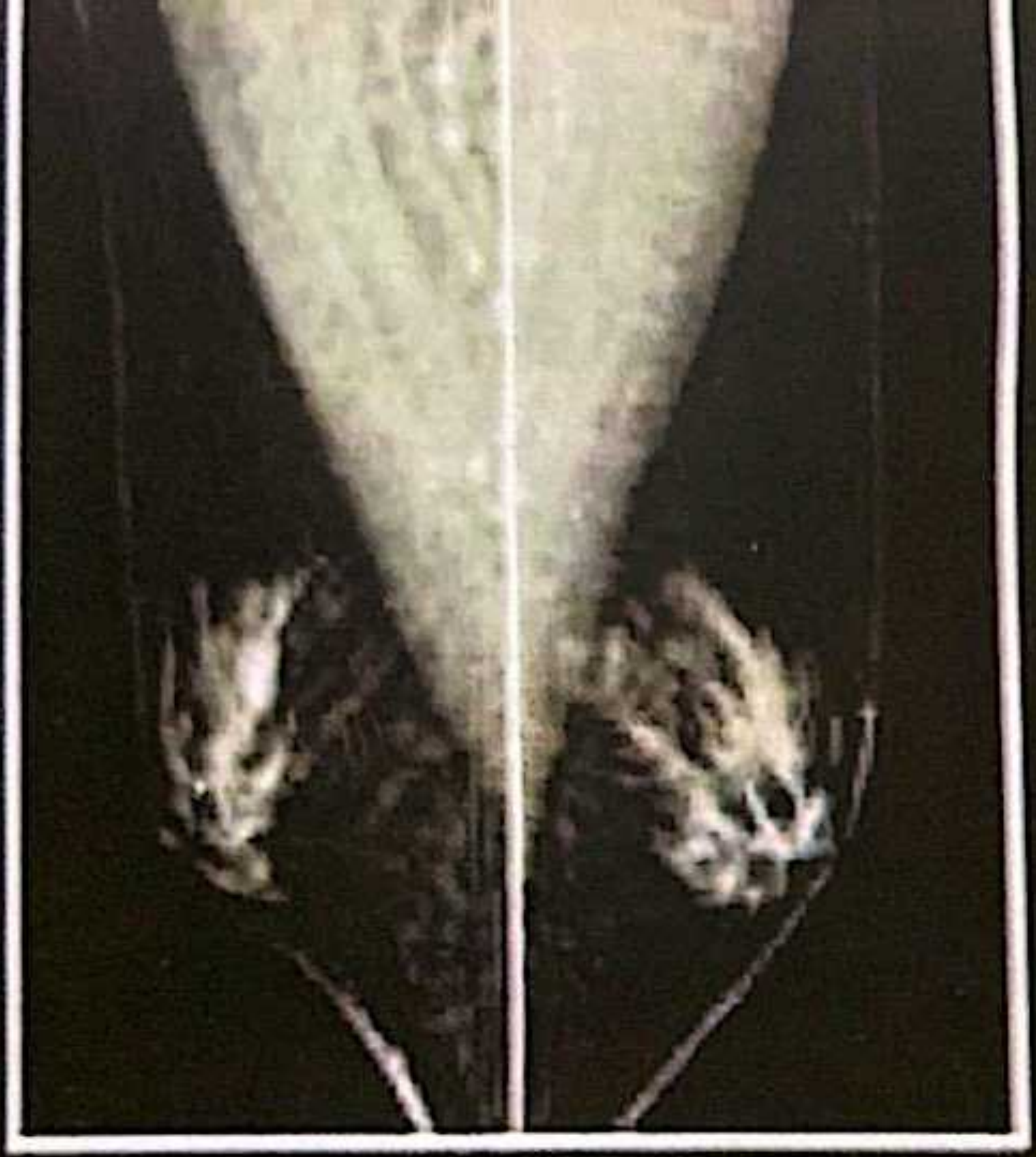
Linguine or keyhole sign = Intracapsular rupture

Free silicone = Extracapsular rupture

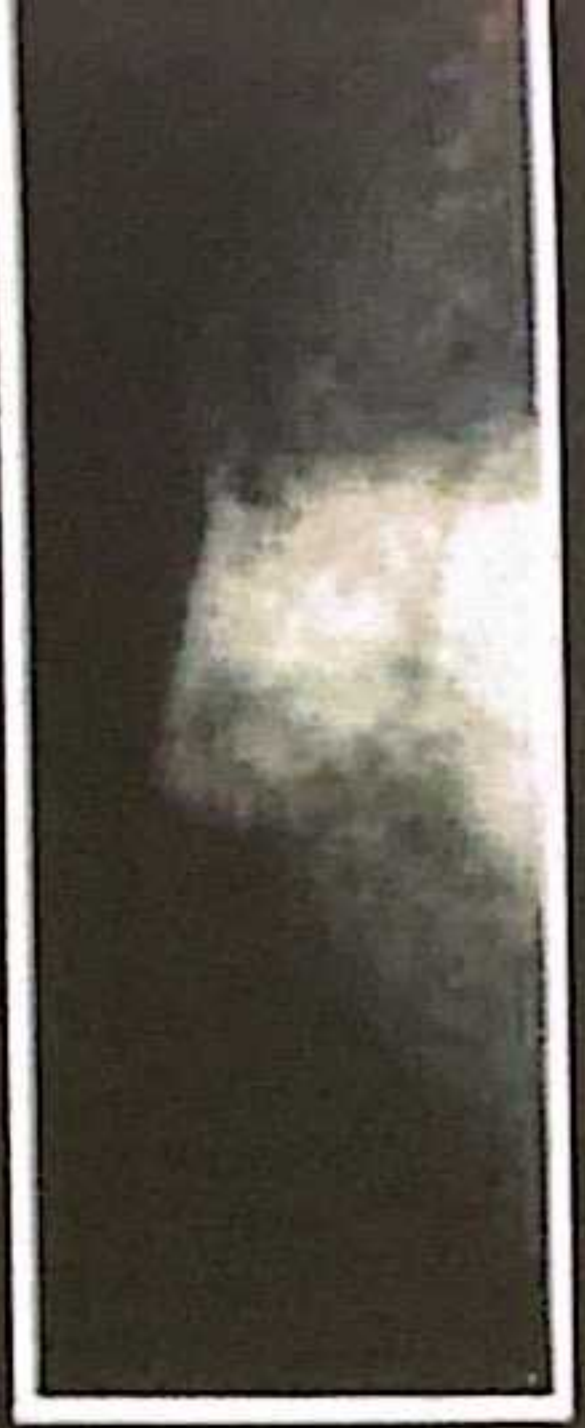

Intracapsular
Extracapsular

Ultrasound

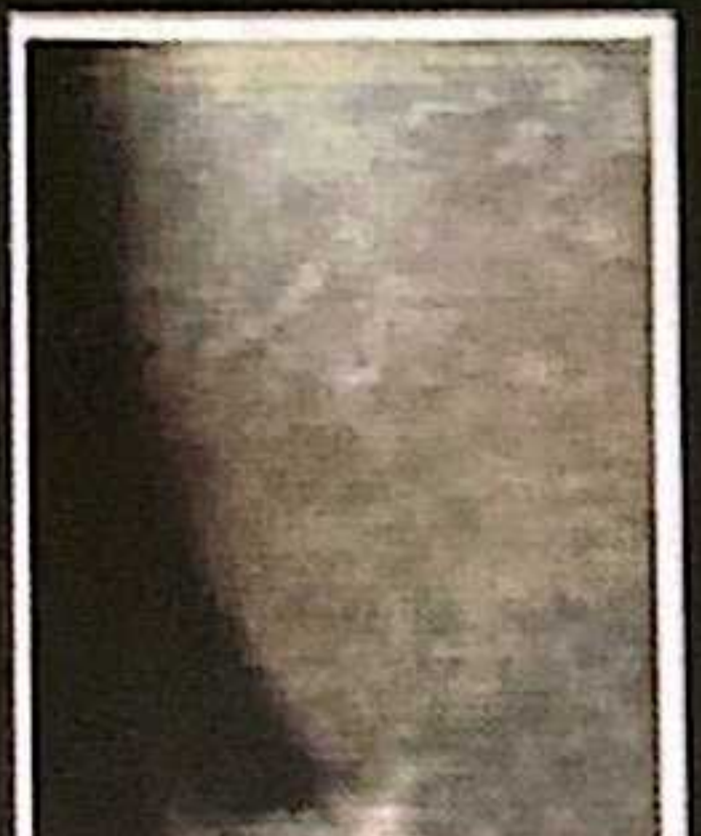

Intracapsular
Stepladder sign
Extracapsular
Snowstorm sig



Gynecomastia

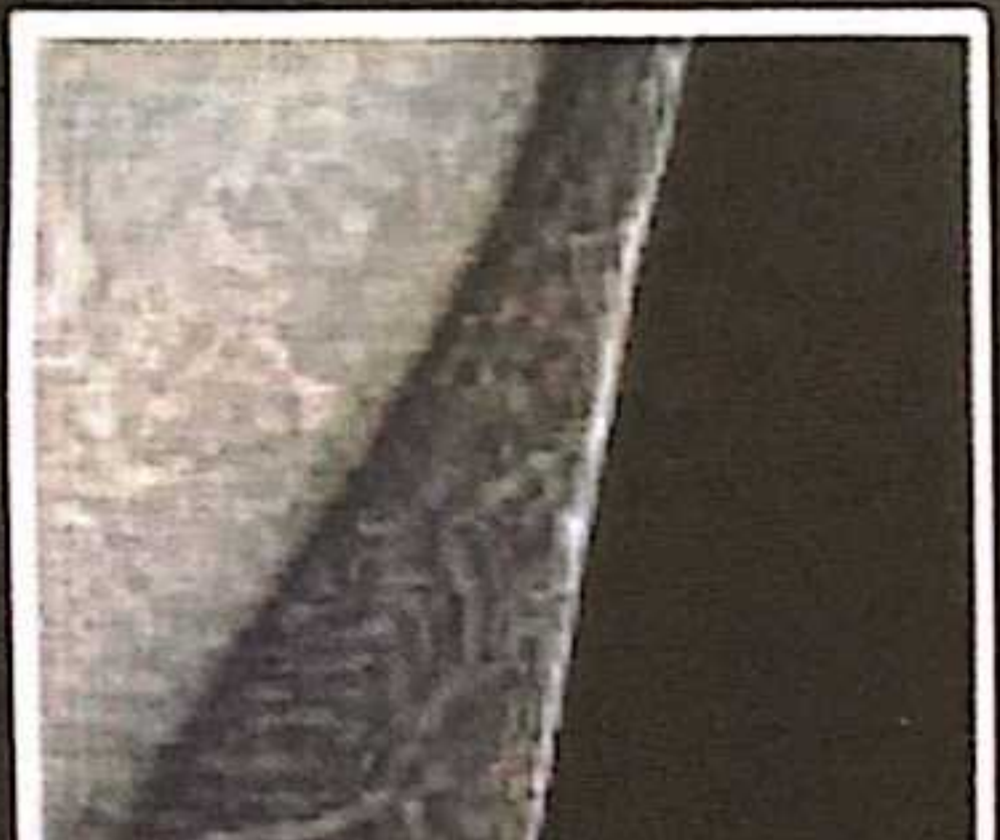


Male IDC

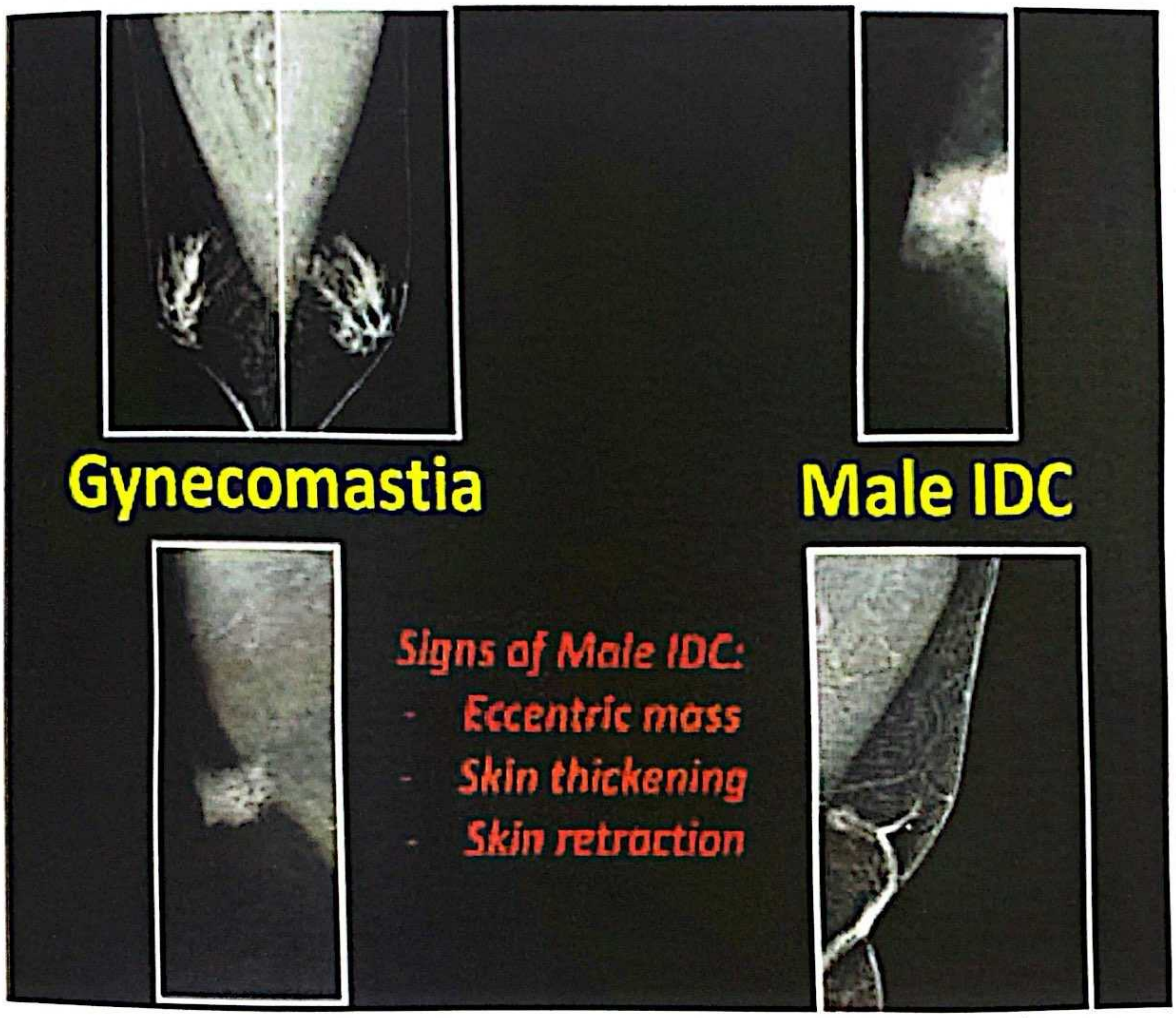


Signs of Male IDC:

- *Eccentric mass*
- *Skin thickening*
- *Skin retraction*



Q.19) Male breast

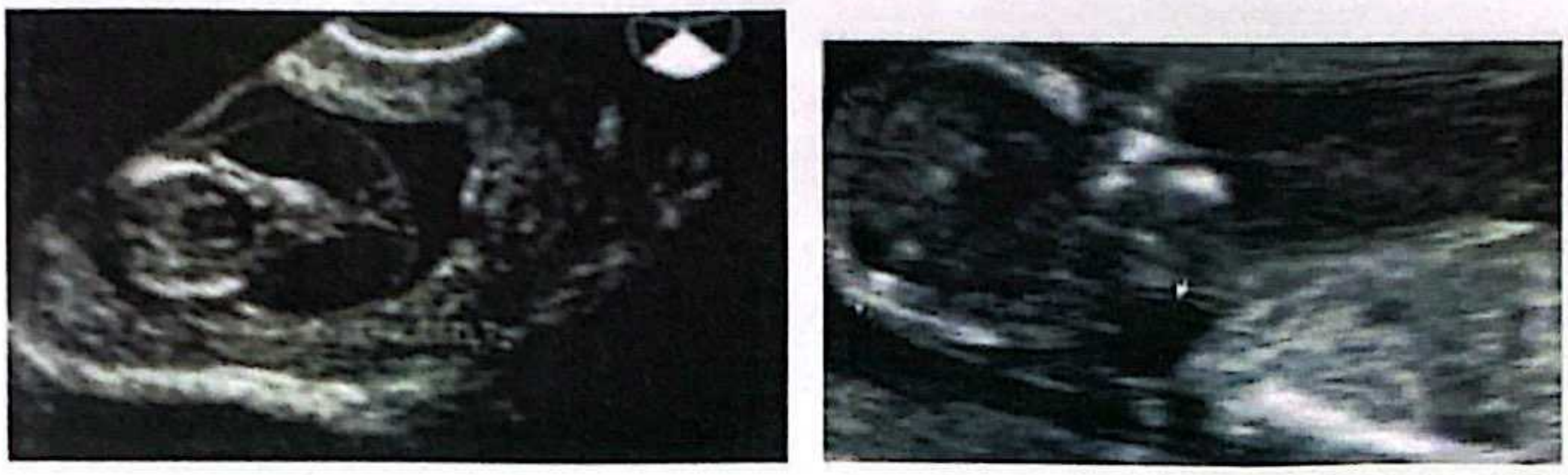

Gynecomastia
Male IDC

Signs of Male IDC:
- Eccentric mass
- Skin thickening
- Skin retraction

OBSTETRICS

Q.1) Patient for early anomaly scan at 12 weeks

(2015)



Identify: Grey Scale antenatal ultrasound showing Intrauterine fetus

Describe: A well-defined cystic lesion is seen in neck extending on both sides of midline. Consequent raised nuchal translucency is seen.

Diagnosis: Cystic hygroma

What next:

CT

Commonly seen as a hypoattenuating ill-defined neck cystic mass.

MRI

- T1: predominantly low signal unless there are haemorrhagic components
- T2: predominantly high signal
- T1C+ (Gd): no enhancement on any component except occasional faint enhancement of rim

Treatment:

- Surgical excision
- Injection with OK-432

Complications

- Development of non-immune hydrops fetalis
- Respiratory obstruction from pharyngeal oedema

Differential diagnosis

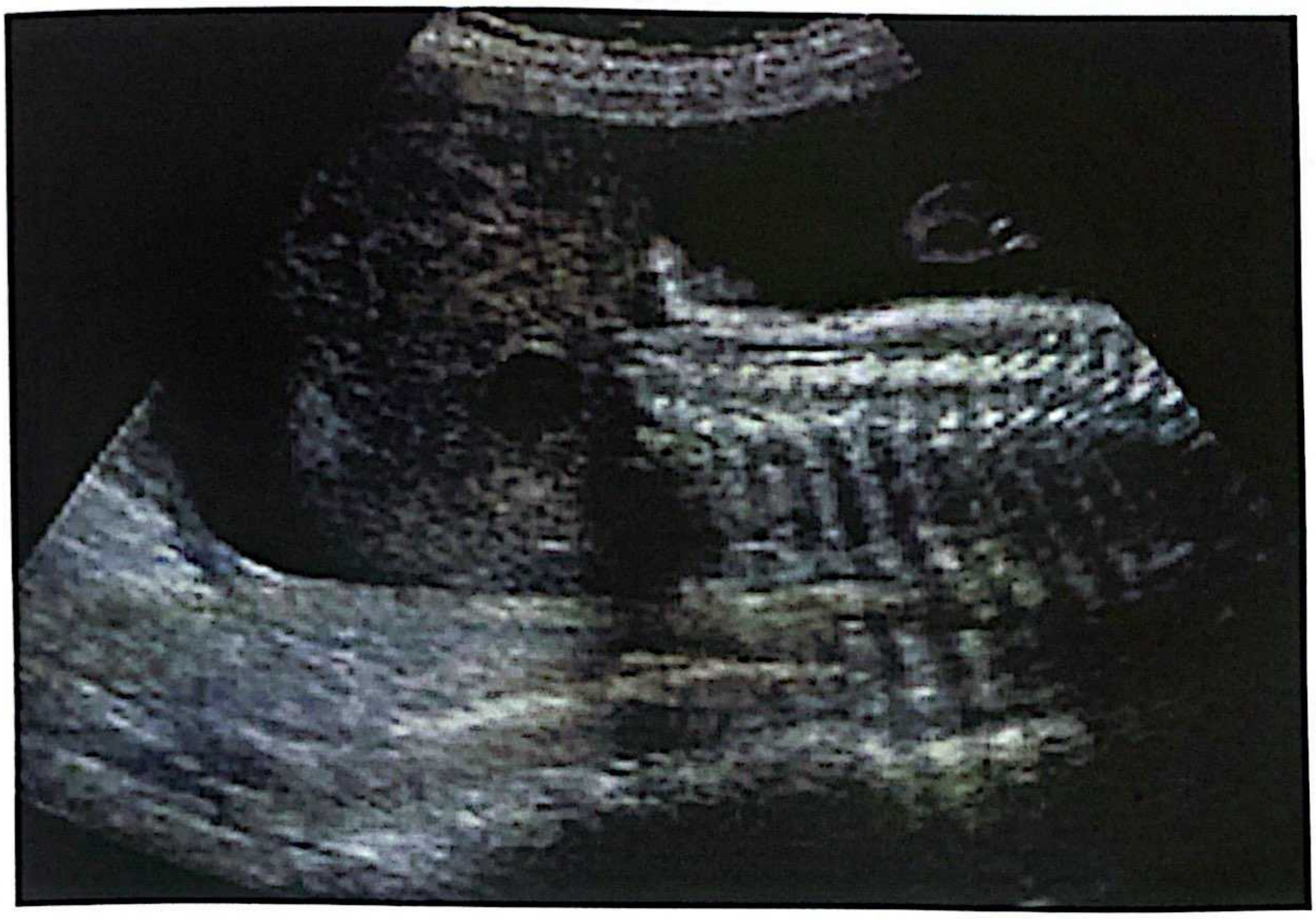
1. Cervical teratoma
2. Occipital encephalocoele
3. Cervical meningocoele

Association:

1. Turner syndrome: most frequent aneuploidic association
2. Down syndrome: second most common aneuploidic association
3. trisomy 13
4. trisomy 18
5. triploidy 11

Q.2) Pregnant woman presented for routine antenatal care-30-40 years-Female

(2015)



Identify: Grey Scale antenatal ultrasound showing Intrauterine fetus
Describe: Huge heterogenous solid mass in sacrococcygeal area of the fetus with abdomino-pelvic extension causing bilateral hydronephrosis
(showing hypervascularity on color doppler)
Diagnosis: Sacrococcygeal teratoma-Type III
What next:

1. **MRI**

- Superior to ultrasound especially in the assessment of the following areas
- colonic displacement
- ureteric dilatation
- associated hip dislocation
- intraspinal extension
- vaginal dilatation
- metastatic assessment in malignant lesions
- T1: fat components appear high signal, calcific/bony components low signal
- T2: fluid (cystic) components appear high signal, calcific bony components low signal

- T2* GRE: magnetic susceptibility artefact because of calcifications
- T1 C+ (Gd): enhancing solid components

2. **Alpha fetoprotein (AFP)**
3. **beta HCG**
4. **Biopsy**

Associations:

1. Myelomeningocoele
2. Vertebral anomalies

Types:

- Type I: developing only outside the fetus
- Type II: extra-fetal with intra-pelvic pre-sacral extension
- Type III: extra-fetal with abdominopelvic extension
- Type IV: tumour developing entirely in the fetal pelvis

Treatment:

1. Treatment is with surgical excision inclusive of coccygectomy
2. Chemotherapy for malignant tumours.

Complications:

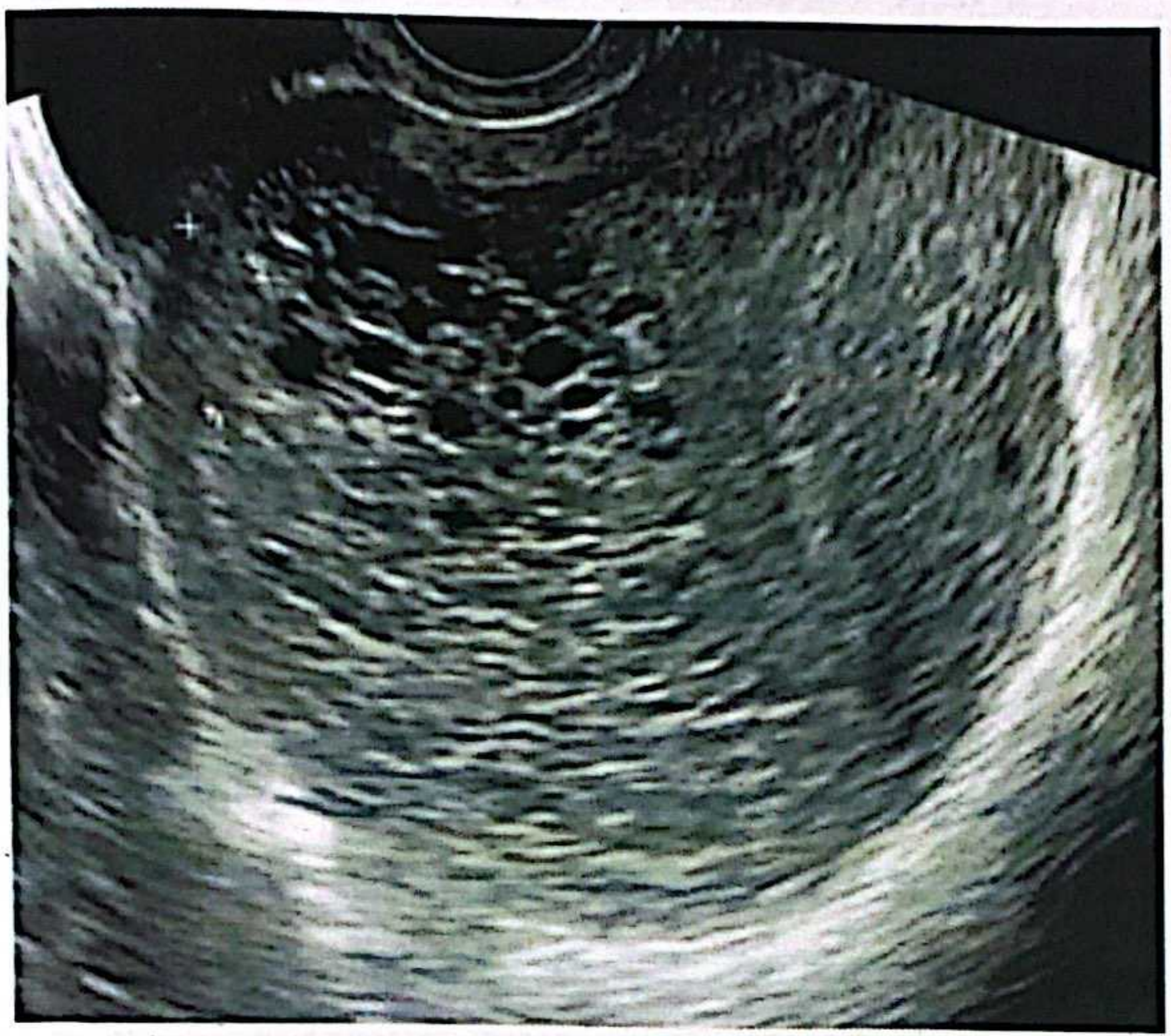
1. High output cardiac failure from AV shunting: which in turn can cause hydrops fetalis
2. Ureteric obstruction
3. Gastro-intestinal tract obstruction
4. Compression of underlying nerves: giving urinary/faecal incontinence
5. Anaemia
6. Dystocia
7. Tumour rupture

Differential diagnosis:

1. Sacral chordoma
2. Terminal myelocystocoele: for cystic types on ultrasound
3. Sacral meningocoele
4. Low-lying neuroblastoma
5. Low-lying rhabdomyosarcoma
6. Small round blue cell tumour in the sacral region

Q.3) 4 months of amenorrhoea followed by bleeding per vaginum-AGE: 25 yrs-Female

(2015)



Identify: Transvaginal Ultrasound Pelvis showing greyscale image of uterus

Describe: Uterus is enlarged and bulky showing numerous small cystic spaces - the "cluster of grapes sign" and snow storm appearance with bilateral theca lutein cysts.

Diagnosis: This case shows typical features of complete hydatidiform mole of molar pregnancy

What next:

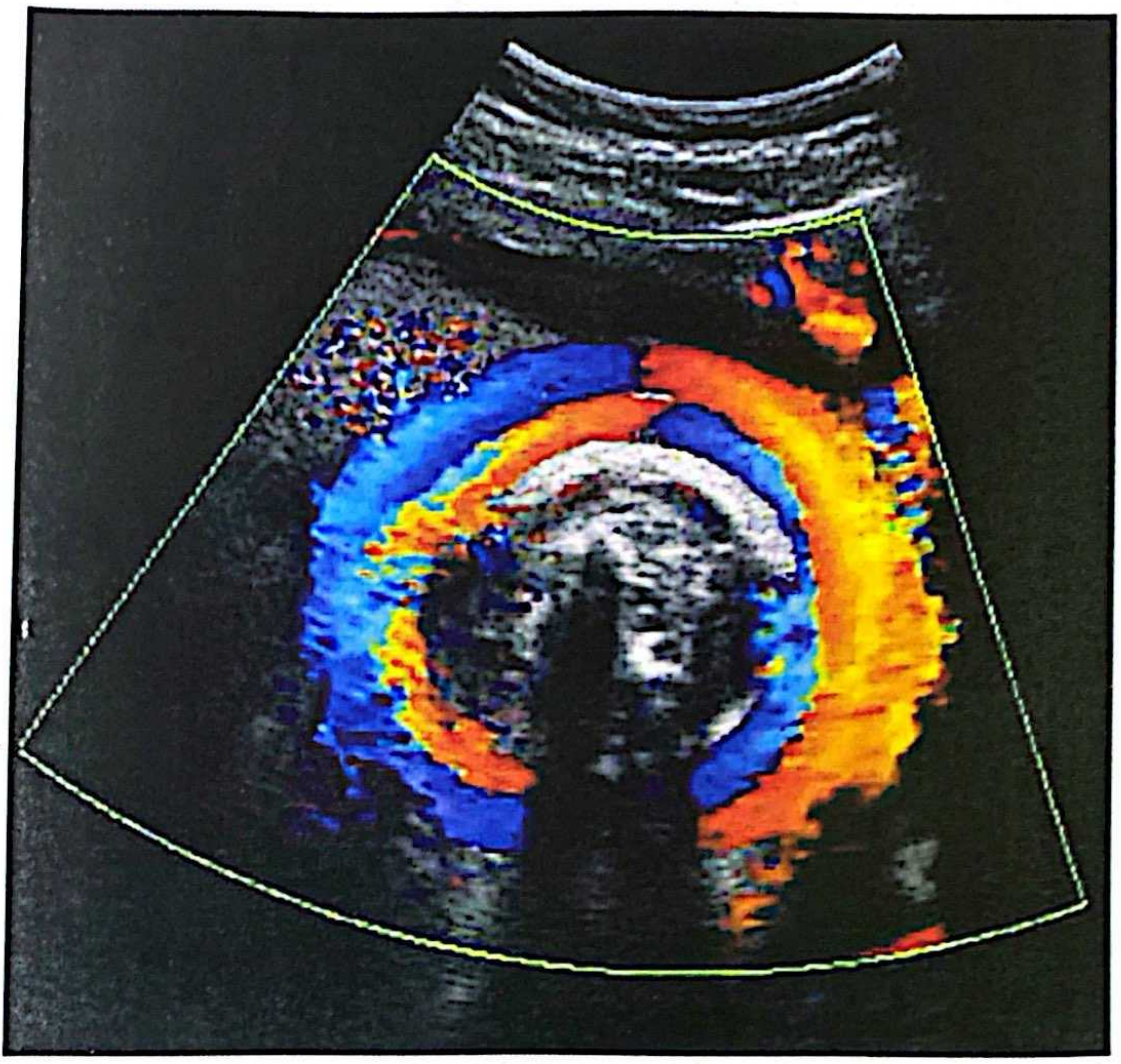
1. **Serum beta HCG levels** are markedly elevated
2. **MRI**

- MRI may demonstrate a heterogeneous mass with cystic spaces distending the uterine cavity.
- T1: there may be areas of high signal corresponding to foci of haemorrhage
- T2: there is heterogeneous high signal from the cystic spaces
- T1 C+ (Gd): often demonstrates intense enhancement due to hypervascularity
- MRI may also demonstrate bilateral theca lutein cysts.

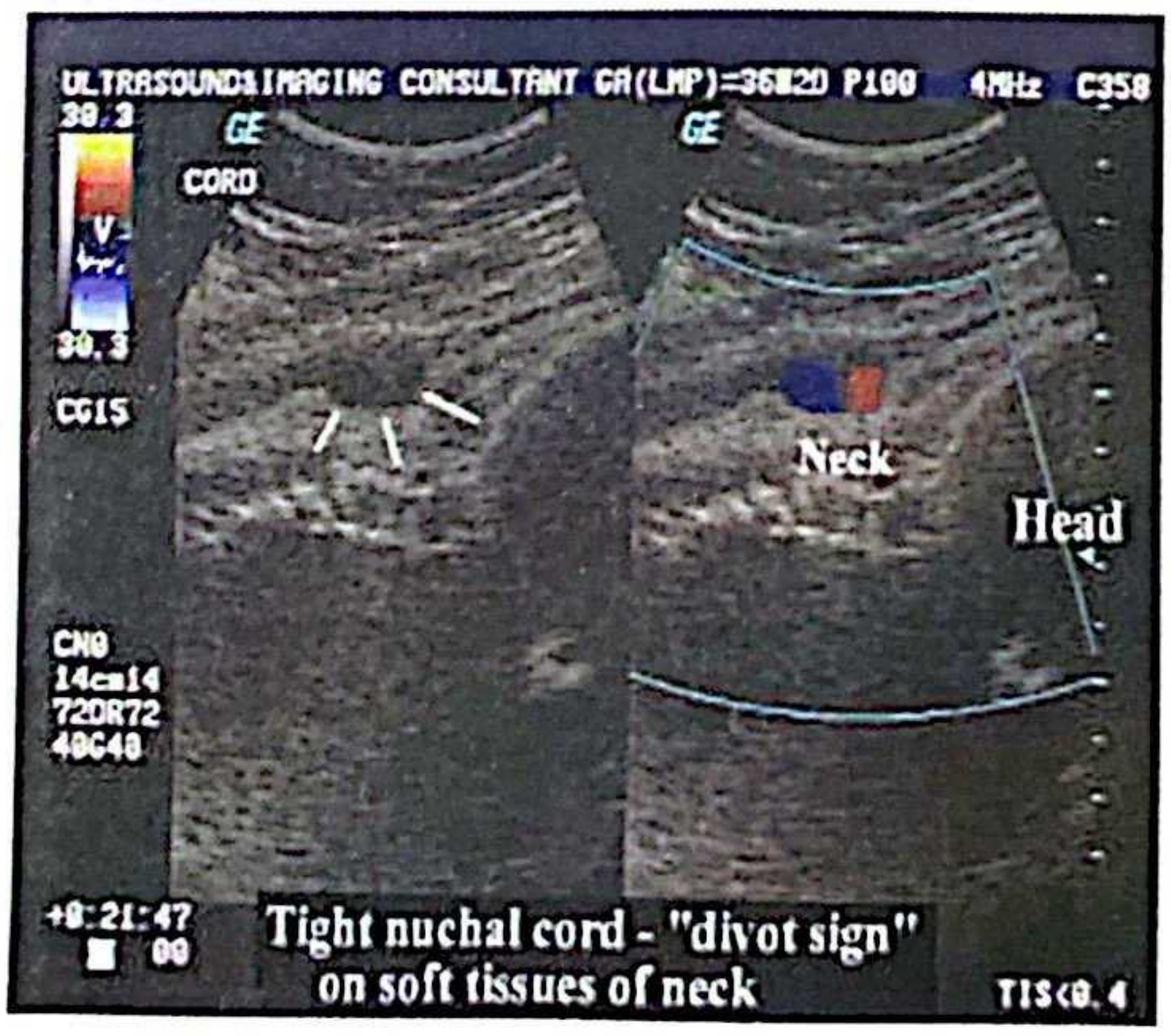
Treatment:

Suction and curettage are used for evacuation are usually the routine treatment.

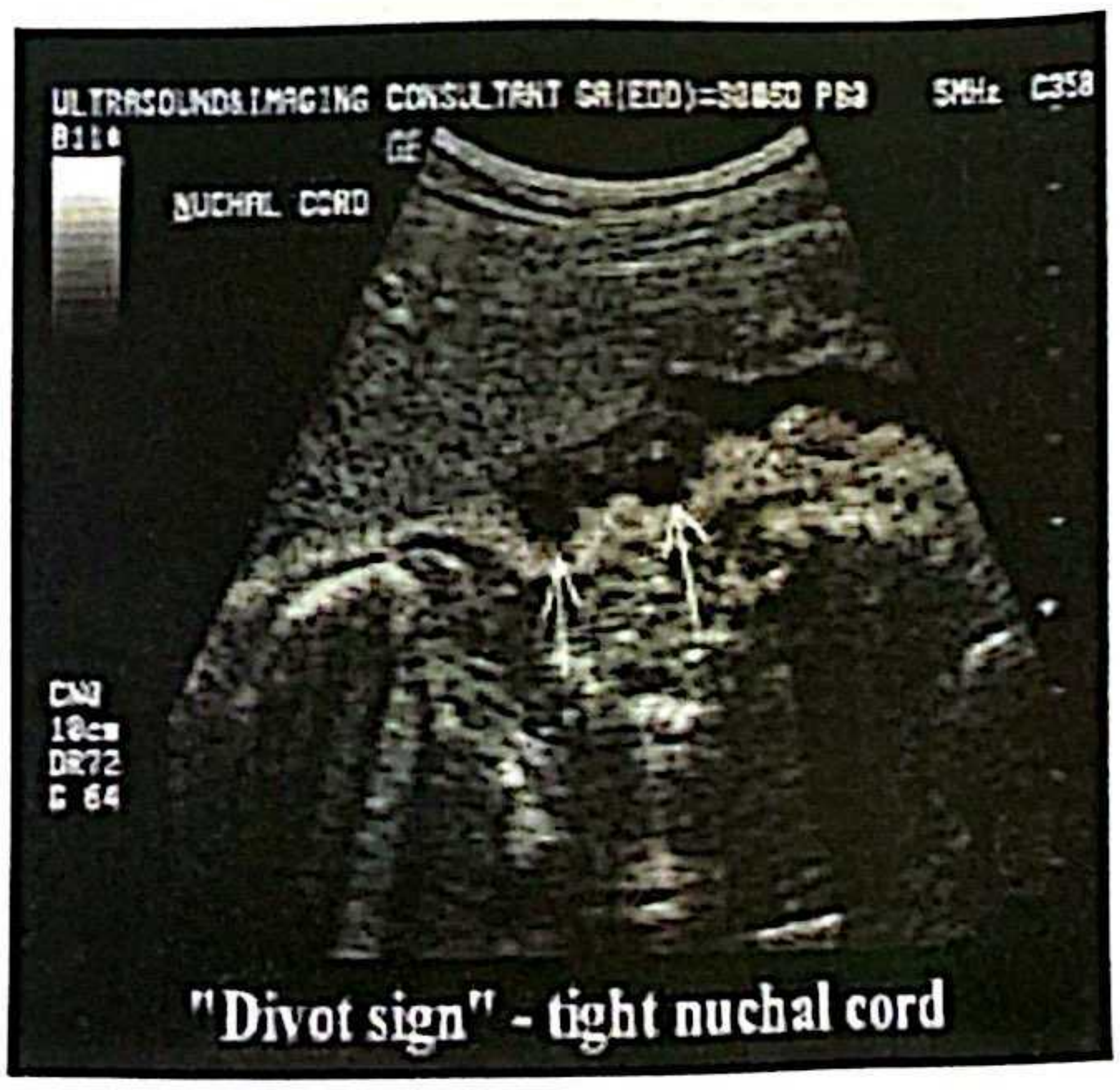
Q.4) Routine 3rd trimester obstetric examination (2014)



Identify: Color doppler ultrasound obstetric transverse section
Describe: A loop of cord showing vascularity & circling around the fetal neck.
An appearance of a small dent or impression due to compression of the fetal neck also present (termed the divot sign).
Diagnosis: Nuchal cord or cord around neck
What are types:
Type I (a): can spontaneously unwind
Type II (b): cannot spontaneously unwind (locking type)

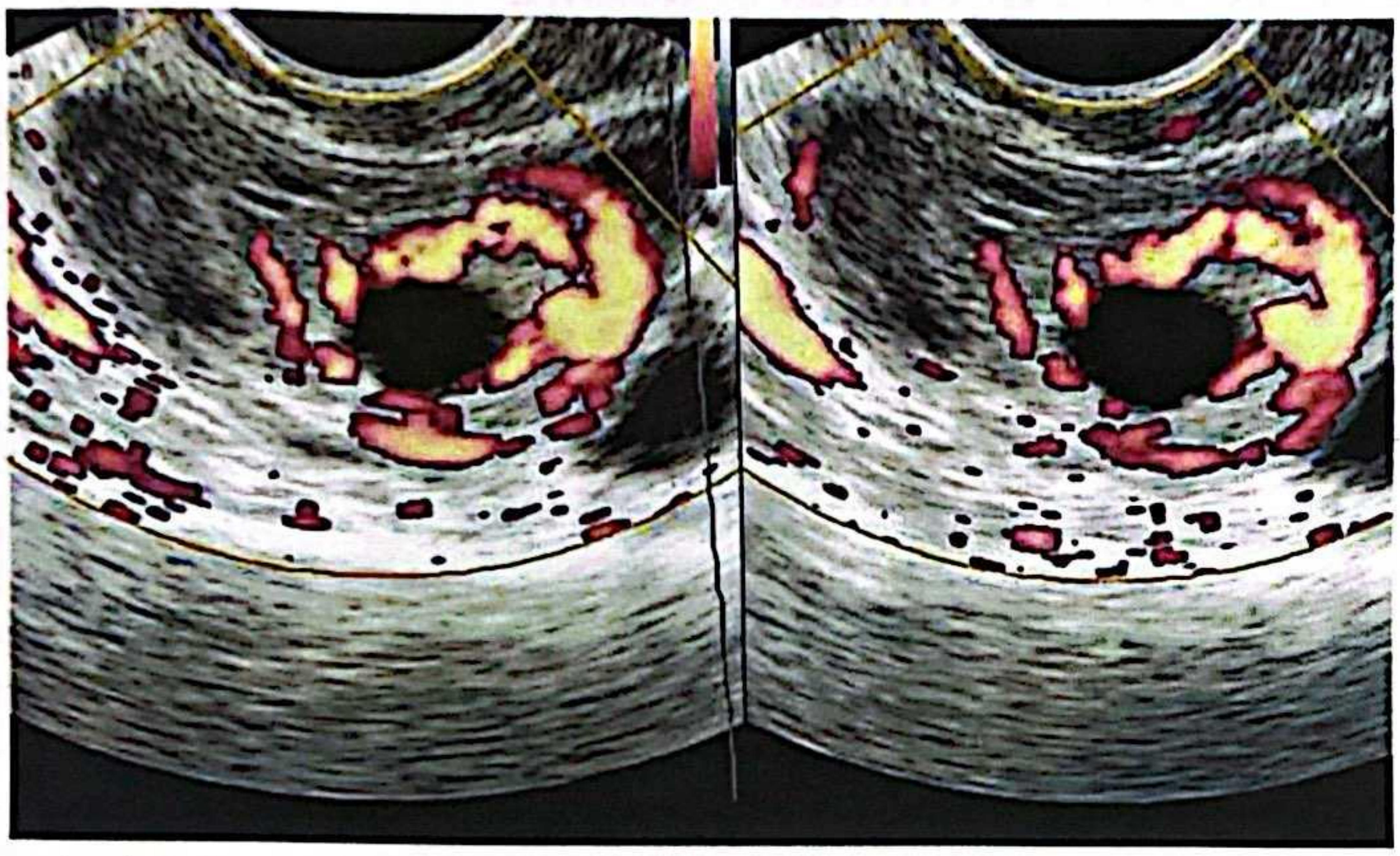

ULTRASOUND&IMAGING CONSULTANT GA(LMP)=36W2D P100 4MHz C358
GE
CORD
CG15
GE
Neck
Head
CN8
14cm14
720R72
40C48
TIS<0.4

Tight nuchal cord - "divot sign" on soft tissues of neck


ULTRASOUND&IMAGING CONSULTANT GA(EDD)=38W5D P63 5MHz C358
GE
NUCHAL CORD
CN1
18cm
DR72
C 64

"Divot sign" - tight nuchal cord

Q.5)



Transvaginal scan showing fluid with debris at the cul-de-sac. Empty endometrium with a normal size. Color and spectral doppler demonstrates a right anechoic tubal mass with fetal heart rate. "Ring of fire" sign (hypervascular ring).

Treatment:

1. surgical: (in the case of tubal ectopics with open or laparoscopic salpingectomy or salpingotomy)

medical

2. methotrexate (a folate antagonist) either administered systemically or by direct ultrasound guided injection or potassium chloride (direct injection only obviously)

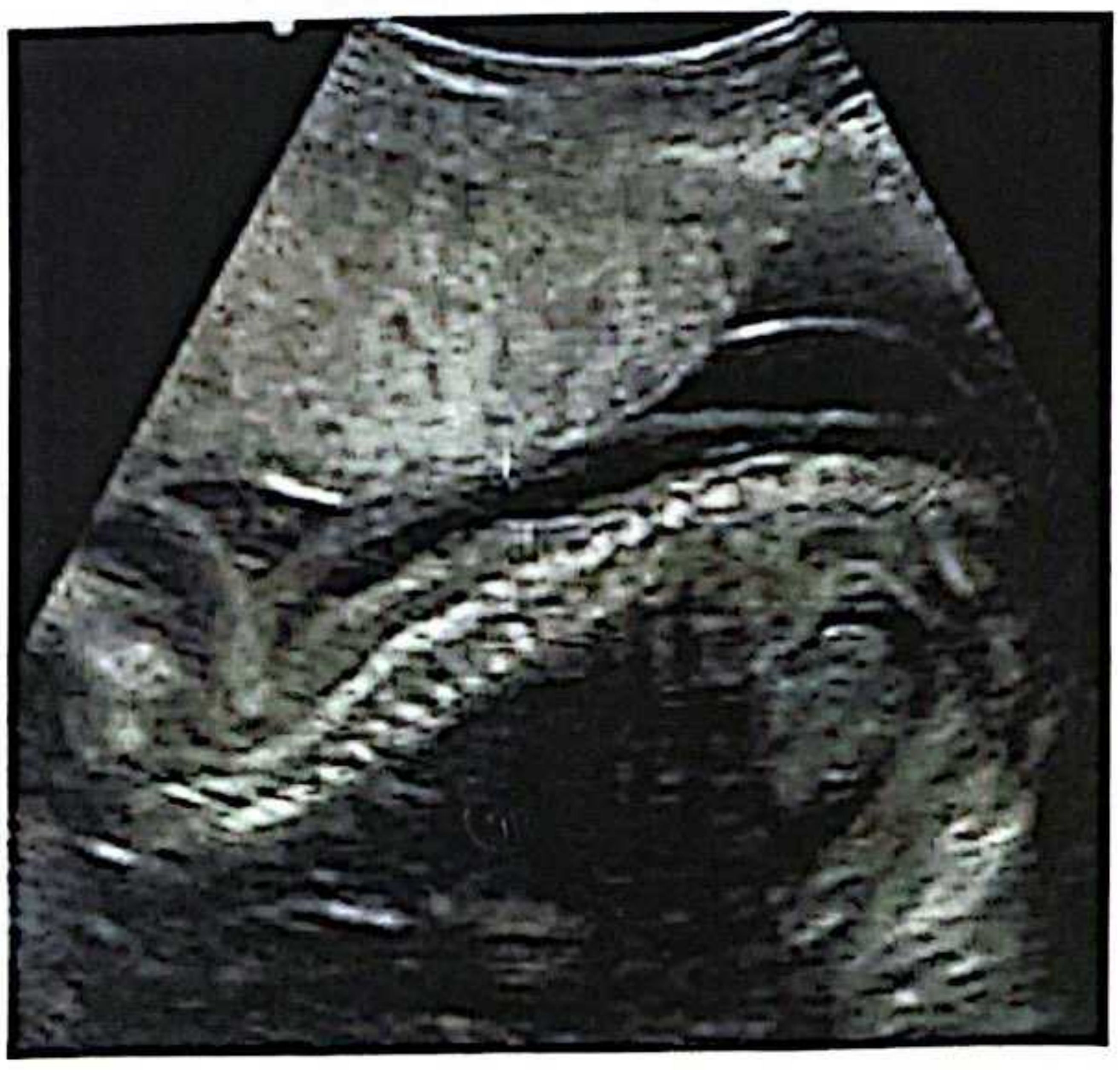
relative contraindications to methotrexate include:

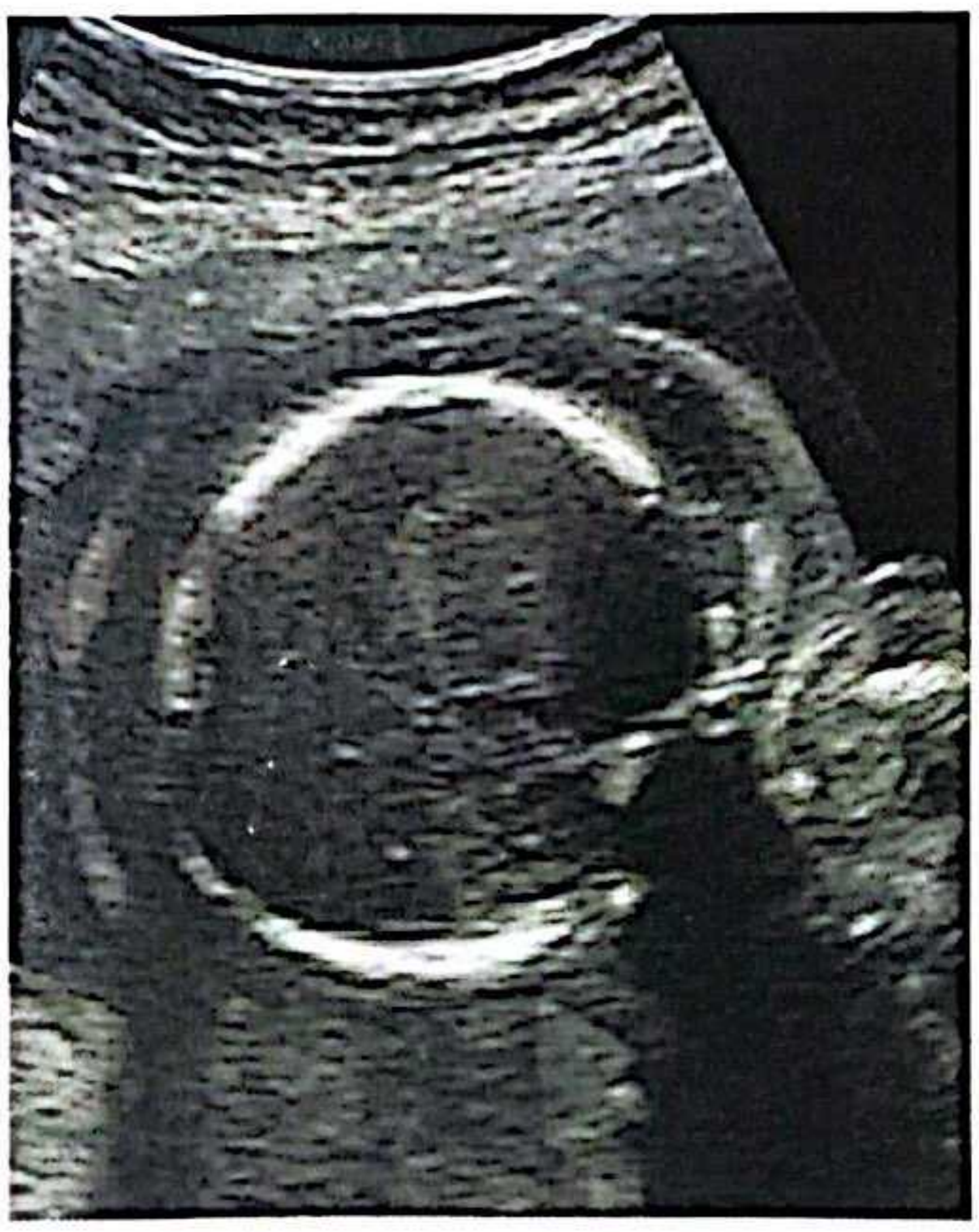
1. rupture
2. mass >3.5 cm
3. fetal cardiac activity
4. bHCG >6000-15,000 mIU/mL

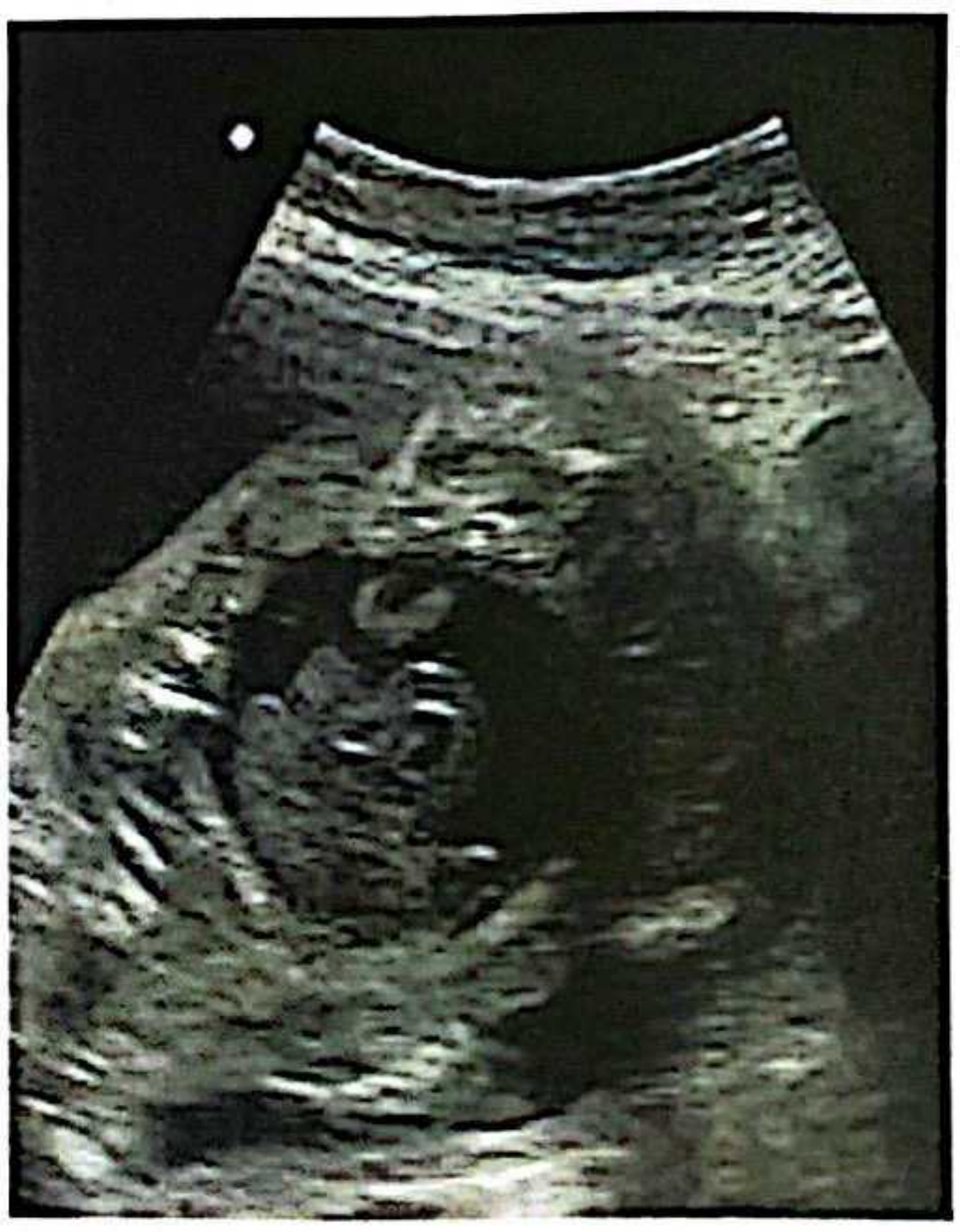
Differential diagnosis

1. ruptured corpus luteum
2. exophytic corpus luteum of pregnancy
3. intrauterine pregnancy
4. incidental adnexal mass
5. appendicitis (negative beta-hCG)

Q.6) Routine antenatal checkup.







The antenatal scan showed subcutaneous oedema including scalp oedema, fetal ascites and placentomegaly suggesting a diagnosis of hydrops fetalis

Antenatal ultrasound

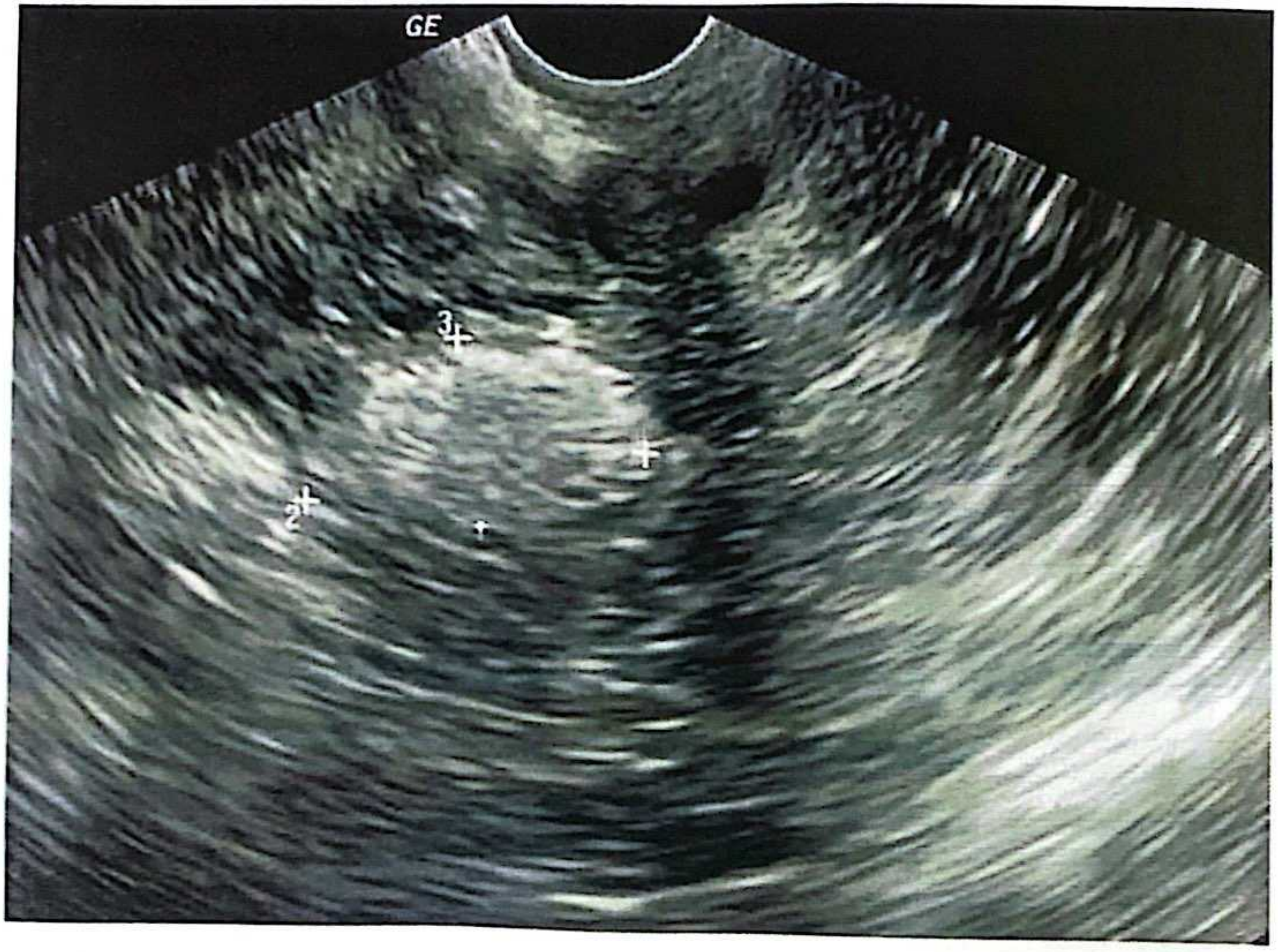
Sonographic features can be similar for both immune and non-immune hydrops and include:

1. increased amniotic fluid volumes
2. increased nuchal translucency (especially 1st trimester 5)
3. larger placental size (placentomegaly) / increased placental thickness (placental oedema)
4. presence of a fetal pleural or pericardial effusion
5. generalised fetal body swelling: fetal anasarca and skin thickening
6. umbilical venous dilatation

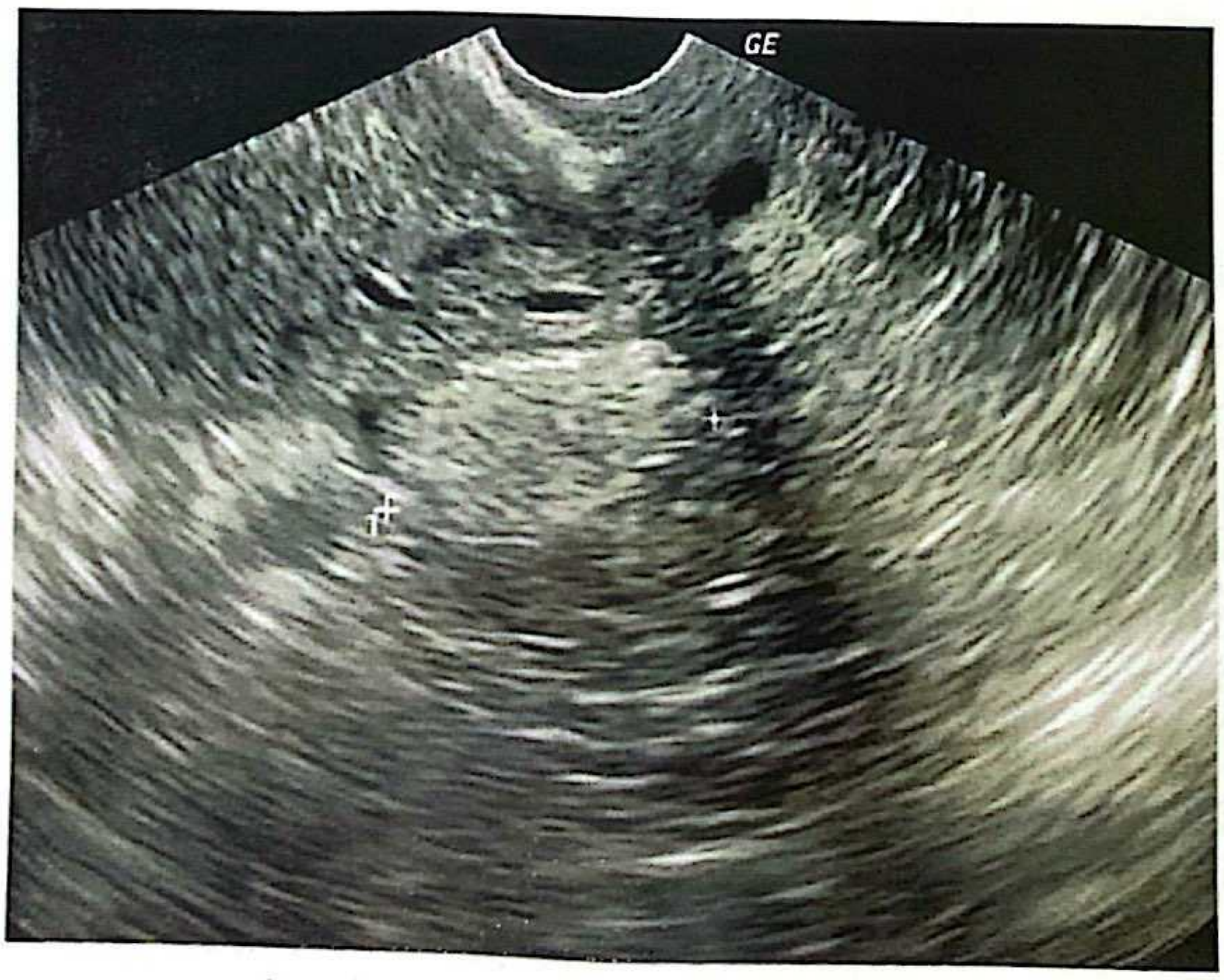
GYNAECOLOGY

Q.1) Lower abdominal pain-25Y-Female

(2017)



Identify: Transvaginal Ultrasound Pelvis showing greyscale image of uterus and adnexae



Describe:

1. Diffusely or partially echogenic mass with posterior sound attenuation

2. An echogenic interface at the edge of mass that obscures deep structures:Tip of the iceberg sign
3. Mural hyperechoic Rokitansky nodule: dermoid plug
4. Echogenic, shadowing calcific or tooth like components
5. Few thin, echogenic bands caused by the hair in the cyst cavity: the dot-dash pattern

Diagnosis: Ovarian dermoid cyst-mature cystic ovarian teratoma

What next:

CT: has high sensitivity in the diagnosis of cystic teratomas

Pelvic MRI: Both fat suppression techniques and chemical shift artefact can be used to confirm the presence of fat.

Treatment:

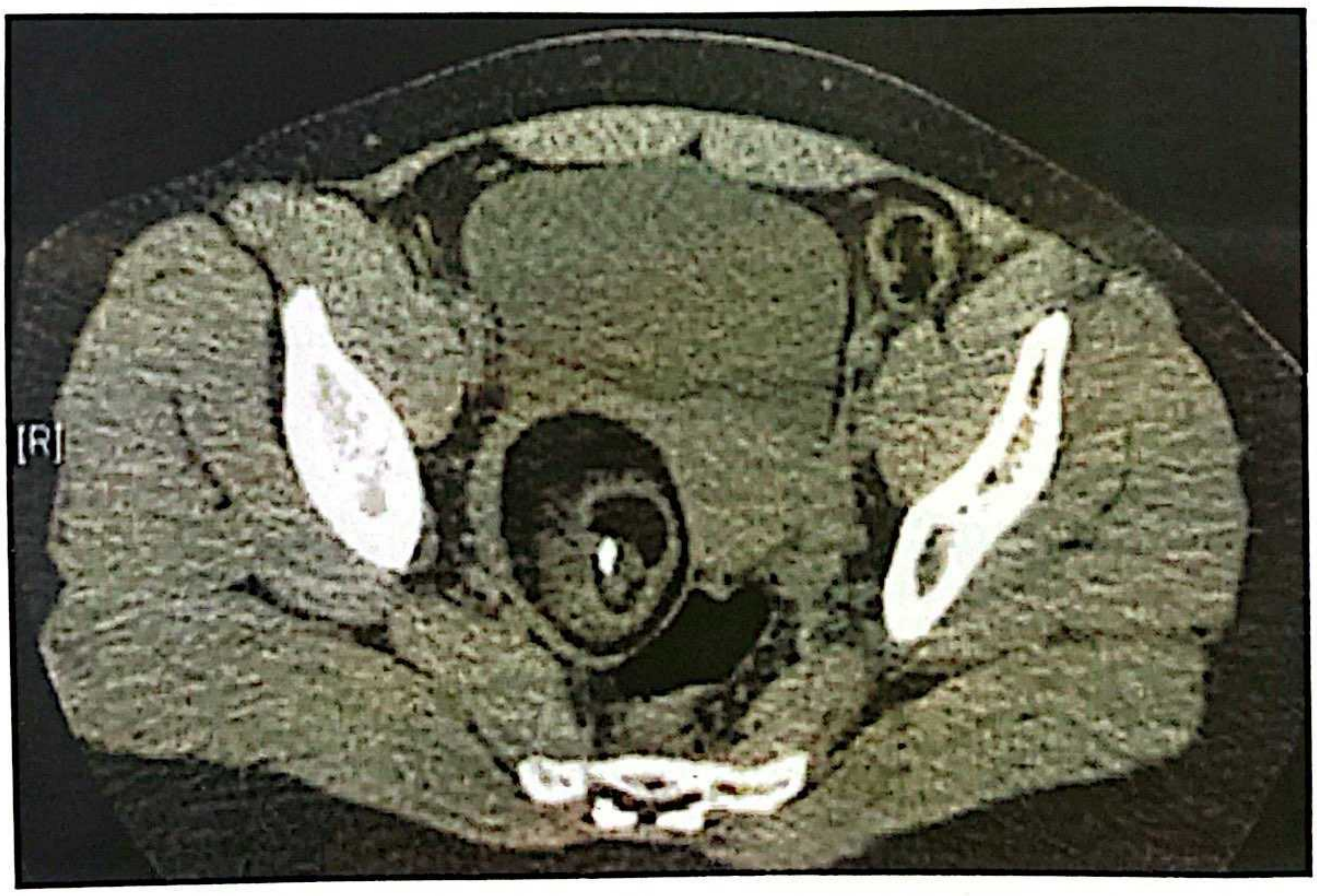
- Larger lesions are often surgically removed.
- Annual follow-up for lesions <7 cm to monitor growth, beyond which a resection is advised.

Complications:

1. ovarian torsion
2. malignant transformation
3. superimposed infection
4. autoimmune haemolytic anaemia

Differential diagnosis:

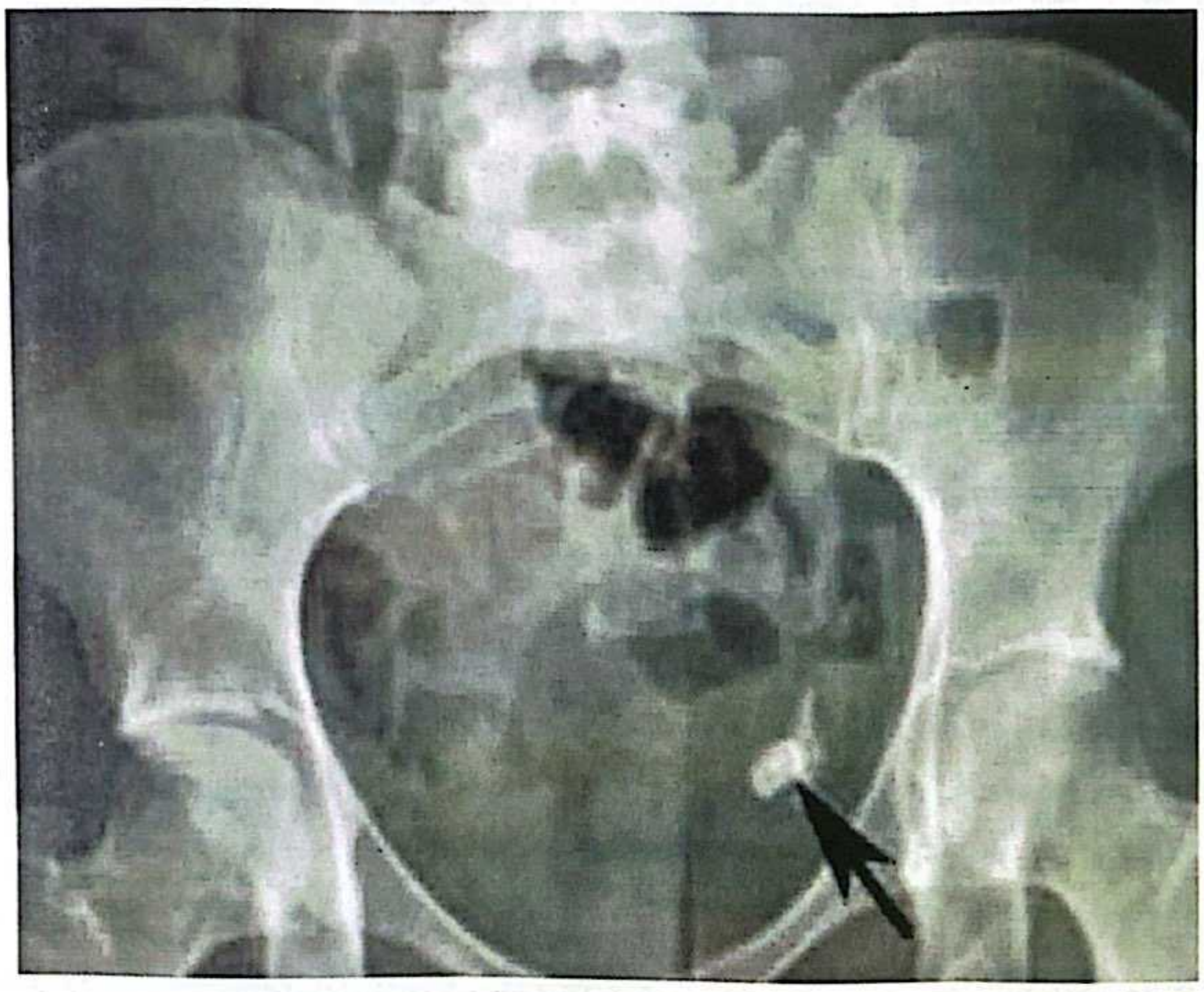
1. Haemorrhagic ovarian cyst
2. Endometrioma
3. Pedunculated lipoleiomyoma of the uterus
4. Immature teratoma

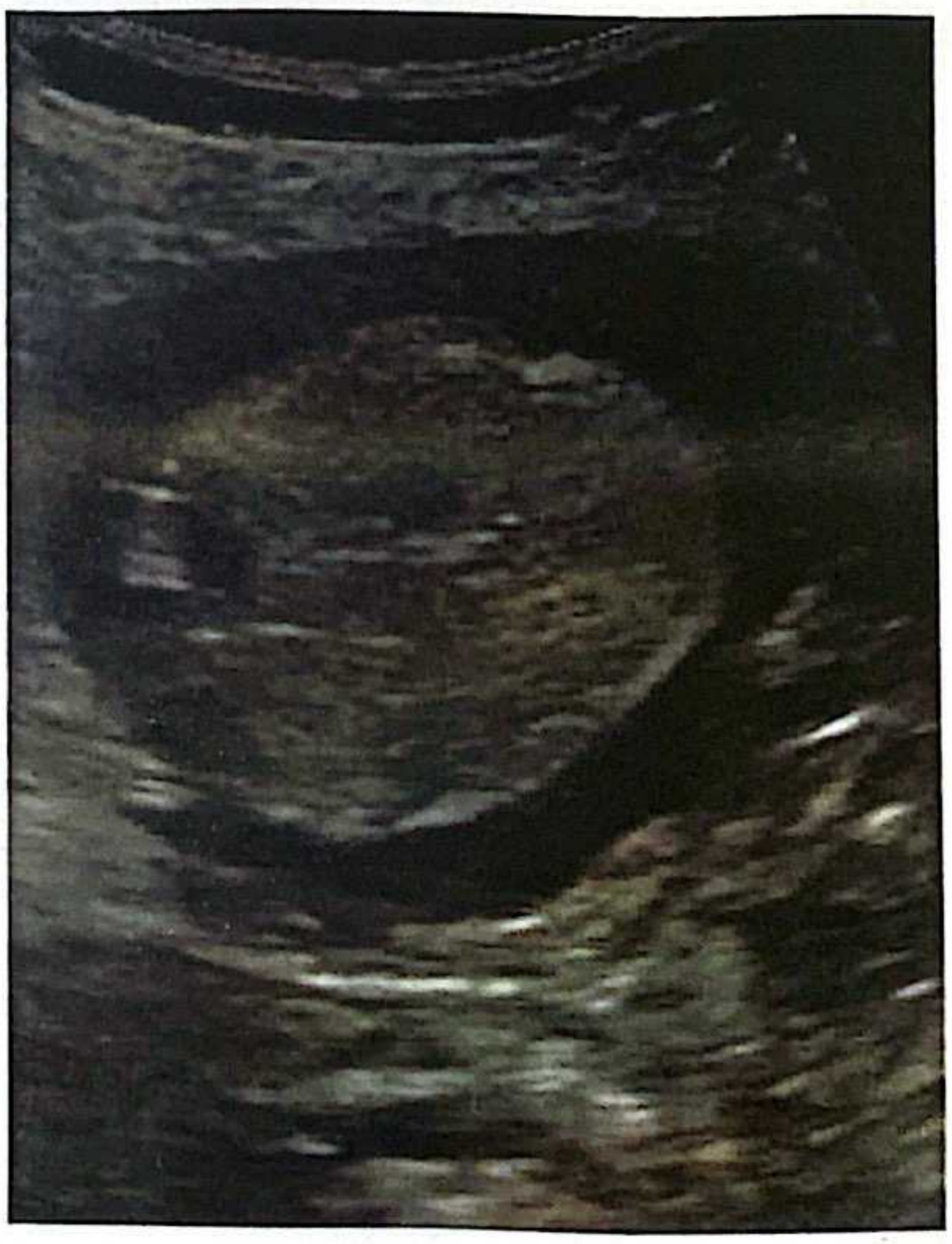


5. Ovarian serous or mucinous cystadenoma/cystadenocarcinoma

Lucency in the pelvis with a calcific density (more or less tooth-shaped) at the periphery (arrow). This is classical of a dermoid cyst with tooth

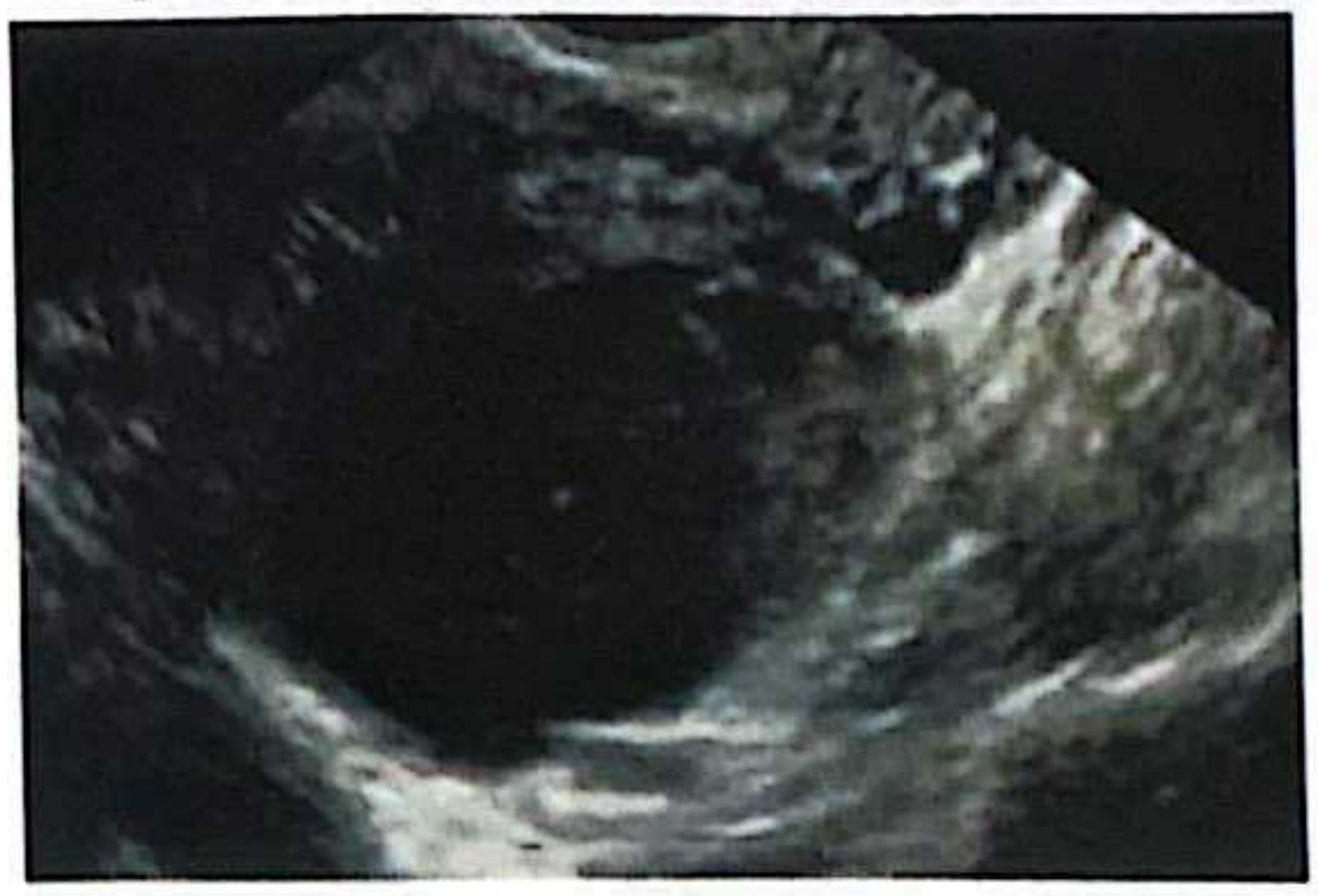
Large well-defined heterogeneous cystic lesion extending from right adnexa up to the level of umbilicus with fluid content, echogenic stripes, area of dense shadowing and a focus of possible tooth/ossification within.





Q.2) Sudden-onset pelvic pain

(2014)



Identify: Transvaginal Ultrasound Pelvis showing greyscale image of uterus and adnexae

Describe: Well defined thin walled oval cystic lesion in the right adnexa abutting the right lateral wall of the uterus with internal lace-like reticular echoes-fluid-fluid level.

Diagnosis: Haemorrhagic ovarian cyst

What next: Follow up-6-12 weeks

MRI:

T1: high signal

T2: high signal

haemorrhage evolves from the centre of the cyst and then extends peripherally (i.e. the centre may show chronic stage of haemorrhage while the periphery is more subacute)

T1 C+ (Gd): No enhancement

How do you differentiate between a hemorrhagic cyst and endometrioma on MRI?

- "T2 shading" is suggestive of chronic blood products and is more typical of endometrioma
- Endometrioma shows high signal in T1 and low signal in T2WIs

Differential diagnosis:

- Cystic ovarian neoplasm
- Endometrioma-typically contains uniform low-level internal echoes with a hypervascular wall on Doppler ultrasound.

Hysterosalpingogram

Hysterosalpingogram (HSG) is a fluoroscopic examination of the uterus and the Fallopian tubes, most commonly used in the investigation of infertility or recurrent spontaneous abortions.

Indications:

- Infertility to assess uterine morphology and tubal patency.

Contraindications

1. Pregnancy

2. Active pelvic infection
3. Recent uterine or tubal surgery

Technique

10-20ml contrast

The procedure should be performed during the proliferative phase of the patient's menstrual cycle (days 6-12), when the endometrium is thinnest

- This improves visualisation of the uterine cavity, and minimizes the possibility that the patient may be pregnant
- If there is any uncertainty about the patient's pregnancy status, a beta hCG is warranted prior to commencing.
- After an antiseptic cleaning of the external genital area, a vaginal speculum is inserted with the patient in the lithotomy position; the cervix is cleaned with an aseptic solution.
- catheterisation of the cervix is then performed; the type of device used depends on local practice preferences-6 Fr Foley catheter with balloon inflation

Process:

- Water soluble iodinated contrast is subsequently injected slowly under fluoroscopic guidance.
- A typical fluoroscopic examination includes preliminary frontal view of the pelvis, as well as subsequent spot images that demonstrate uterine endometrial contour, filled fallopian tubes and bilateral intraperitoneal spill of contrast, to establish tubal patency.

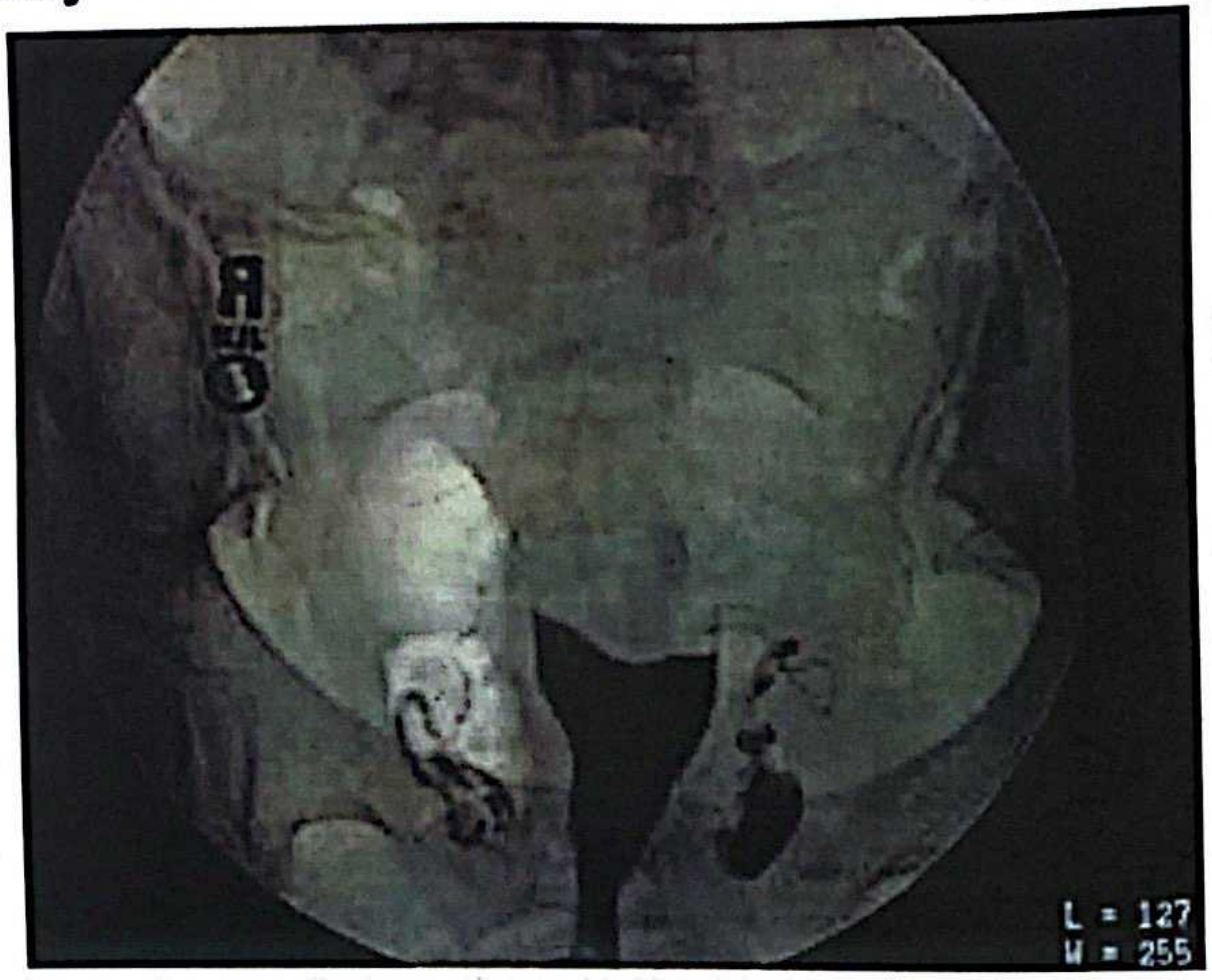
Complications

1. Common but self-limiting
2. Abdominal cramping
3. PV spotting
4. Venous extravasation
5. Pelvic infection
6. Contrast reaction
7. Detectable pathology

Conditions which may be detected with HSG include:

1. Uterine
2. uterine congenital anomalies
3. submucosal uterine fibroids
4. uterine malignancy
5. adenomyosis
6. intrauterine adhesions
7. uterine (endometrial) polyps

Q.3) Infertility (2016)



Identify: Hysterosalpingogram

Describe: No immediate spill from the left fallopian tube Delayed spill occurs from the Right tube.

Diagnosis: Left sided hydrosalpinx

What next: Prescribe postprocedural antibiotic prophylaxis (eg, doxycycline) to prevent procedure related infection

Ultrasound

- Thin- or thick-walled (in chronic cases)
- Elongated or folded, tubular, C-shaped, or S-shaped fluid-filled structure distinct from the uterus and ovary.
- Longitudinal folds that are present in a normal fallopian tube may become thickened in the presence of a hydrosalpinx. The folds may produce a characteristic "cogwheel" appearance when imaged in cross section. These folds are pathognomonic of a hydrosalpinx.
- Incomplete septae may also give a "beads on a string" sign.

CT

A fluid-attenuation tubular adnexal structure, separate from the ovary. A simple hydrosalpinx is not accompanied by pelvic inflammation. The tubal wall may enhance following contrast.

MRI

MR imaging is the modality of choice for the characterisation and localisation of adnexal masses that are inadequately evaluated with ultrasound. A dilated fallopian tube is interposed between the uterus and ovary and demonstrates fluid signal intensity. Incomplete septa or folds can be seen. The mucosal plicae are usually effaced, and the tube wall is uniformly smooth and thin.

- T1: Typically hypointense although can be hyperintense if there is proteinaceous fluid
- T2: Hyperintense
- T1 C+ (Gd): Mucosal plicae and the tube walls may show mild enhancement

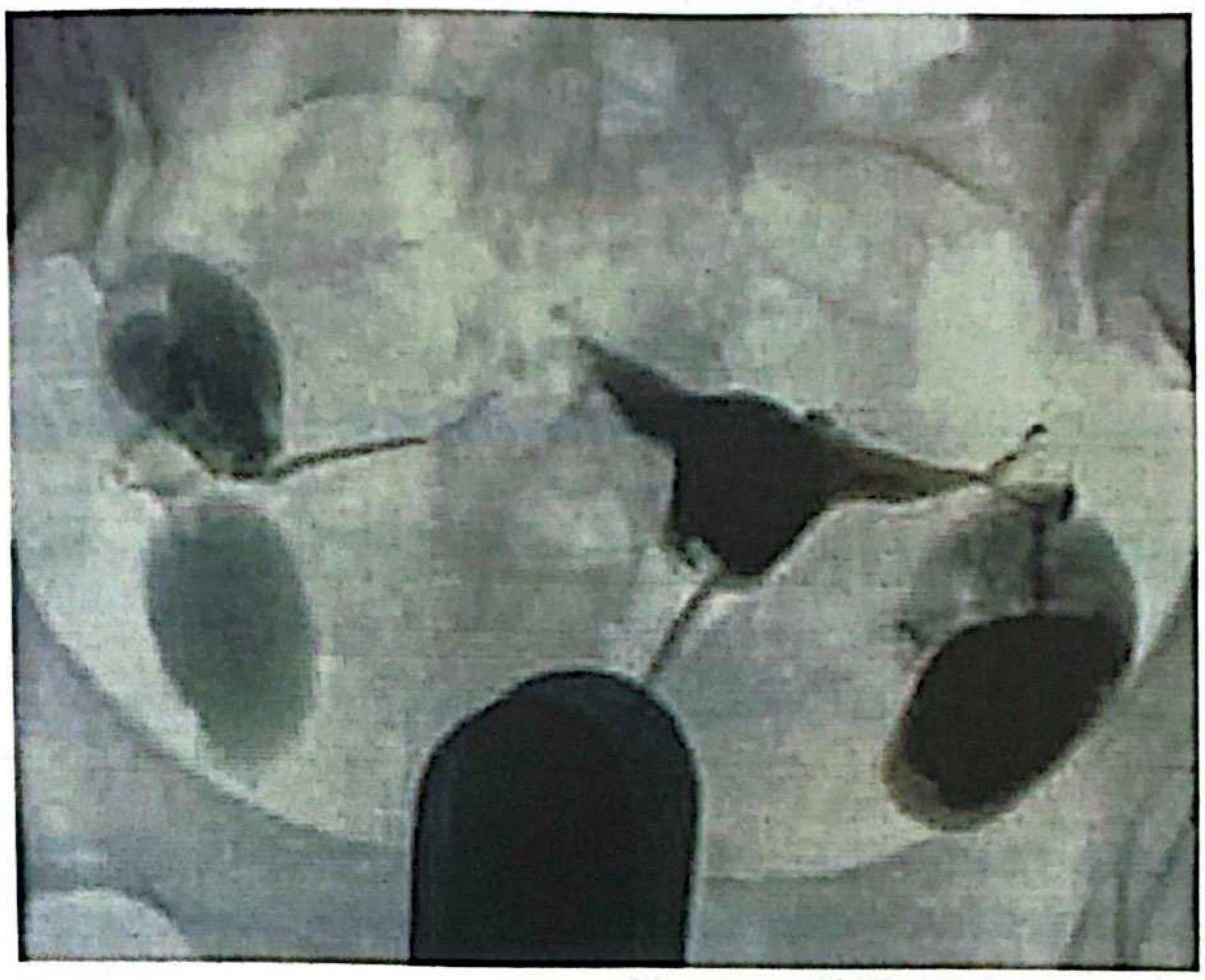
Complication:

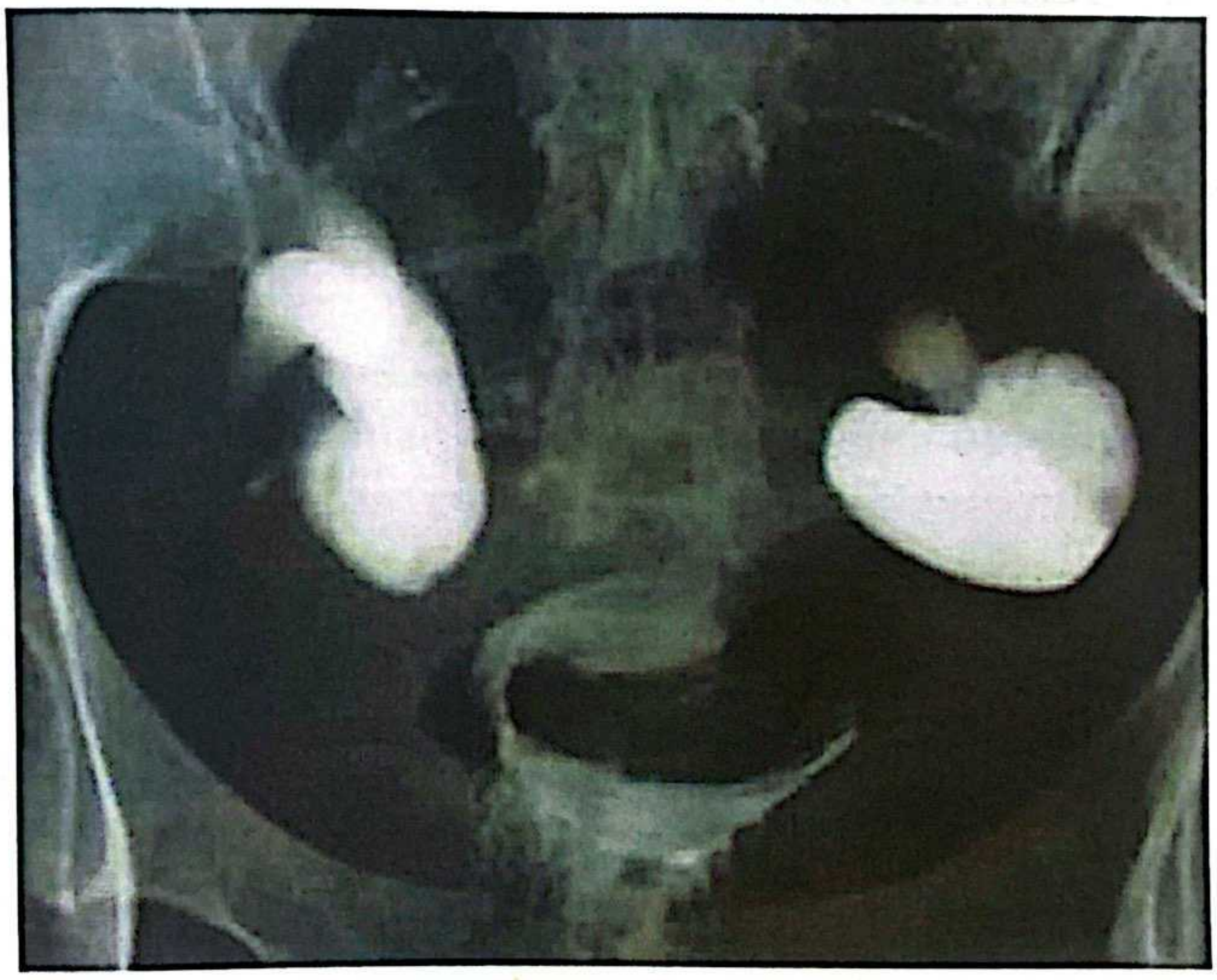
- Tubal torsion

Differential diagnosis:

1. Elongated para-ovarian cyst
2. Cystic ovarian neoplasm(s)
3. Bowel obstruction: at the pelvic level with dilated bowel loops : a dilated tube can be distinguished from Pelvic bowel loops from the lack of peristalsis
4. Dilated pelvic veins: pelvic veins can be recognized from the presence of moving low-level internal
5. Elongated pelvic perineural cyst

Q.4) Infertility **(2013)**





Identify: Hysterosalpingogram AP Projection with and without canula Images

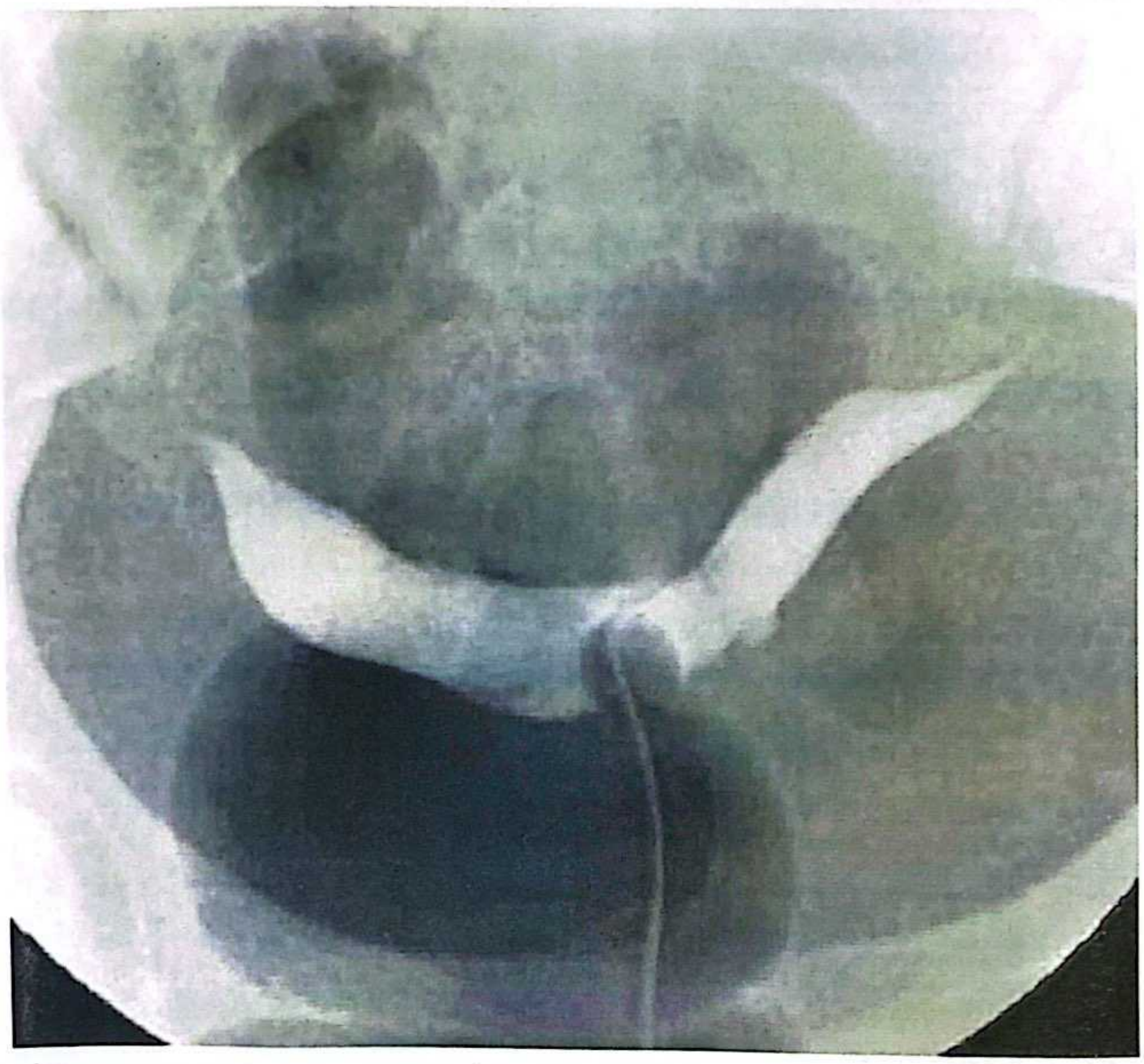
Describe: Bilateral dilated distal fallopian tubes are seen without free spillage of contrast into the peritoneal space.

After cannula removal persistent retention of contrast in the dilated distal fallopian tubes

Diagnosis: Bilateral hydrosalpinges

What next: Prescribe postprocedural antibiotic prophylaxis (eg, doxycycline) to prevent procedure related infection

Q.5) Primary infertility. (2014)



Identify: Hysterosalpingogram AP Projection Spot Film Image

Describe: Contrast opacified two endometrial cavities and cornua. Increased intercornual distance. No opacification of fallopian tubes or free peritoneal spillage.

Diagnosis: Bicornuate uterus

What next: Prescribe postprocedural antibiotic prophylaxis (eg, doxycycline) to prevent procedure related infection

MRI-May help confirm anatomy by showing a deep (>1 cm) fundal cleft in the outer uterine contour and an intercornual distance of >4 cm. The uterus demonstrates normal uterine zonal anatomy.

Ultrasound: Intercornual angle of>75-105° (demonstrated on luteal-phase US in conjunction with HSG)

Treatment:

- Strassman metroplasty
- Placement of a cervical cerclage

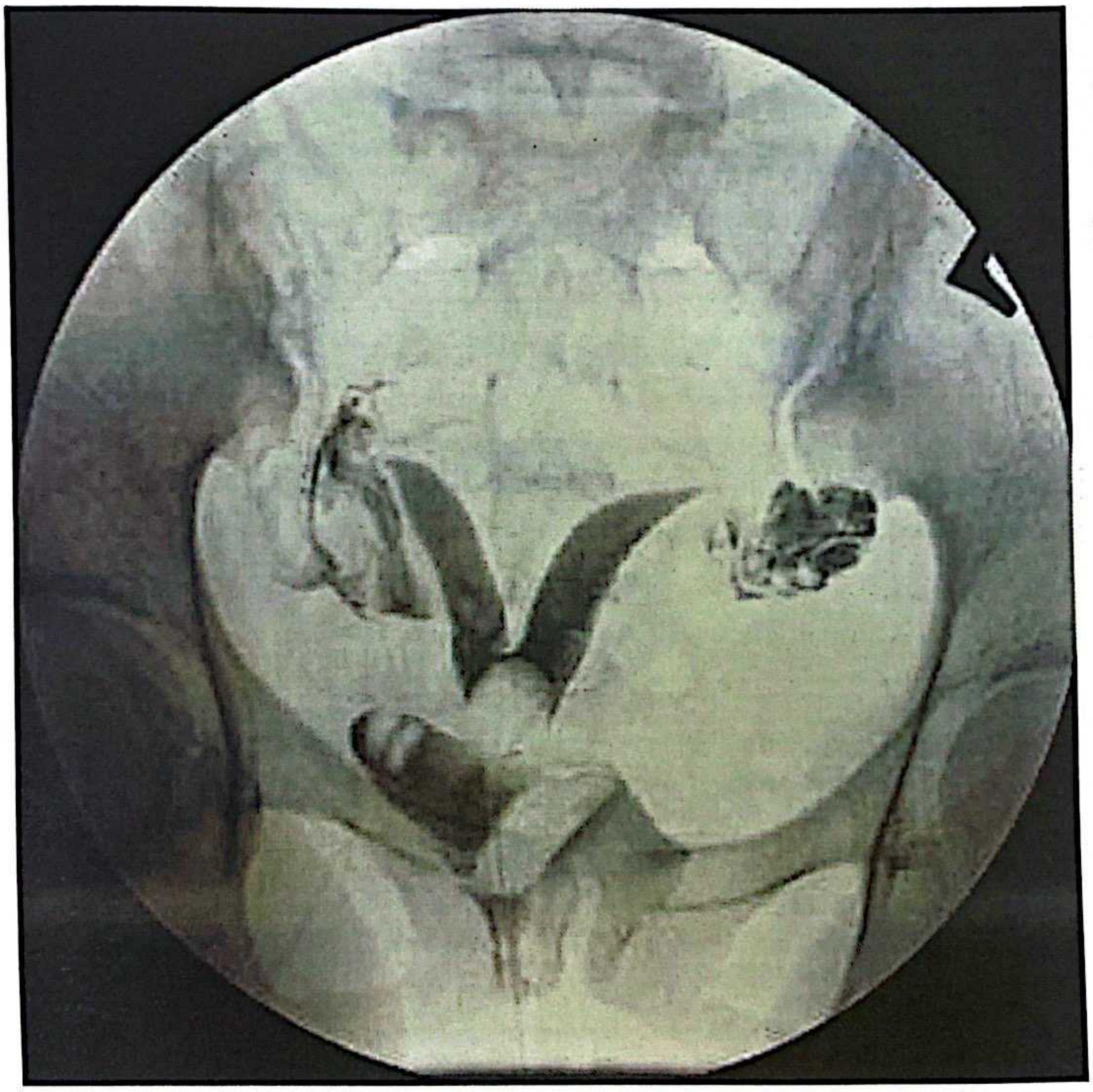
Complications:

1. Repeated spontaneous abortions
2. Premature rupture of membranes
3. Premature labor

4. SGA infant
5. Persistent malpresentations (transverse lie)

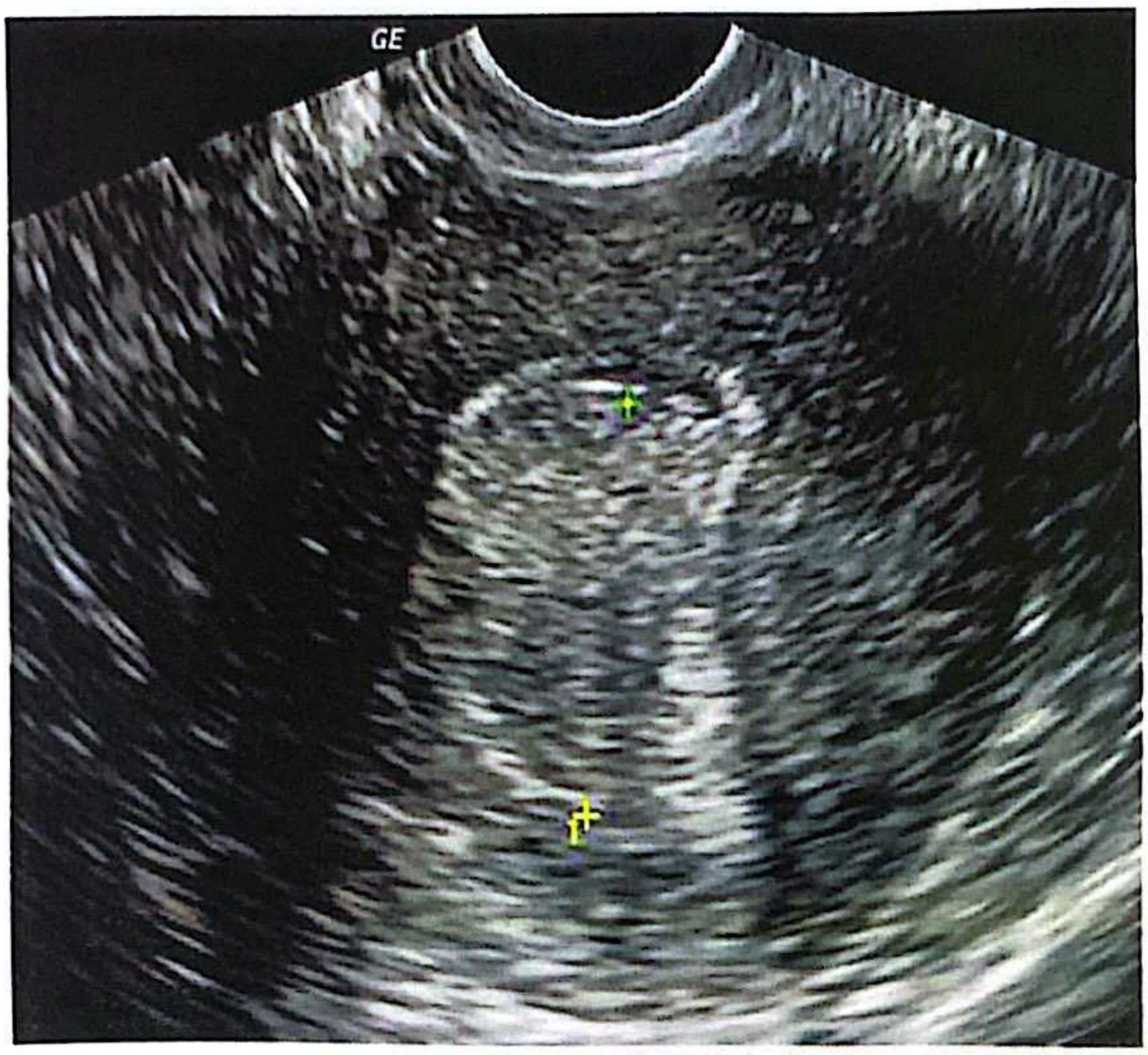
Differential diagnosis

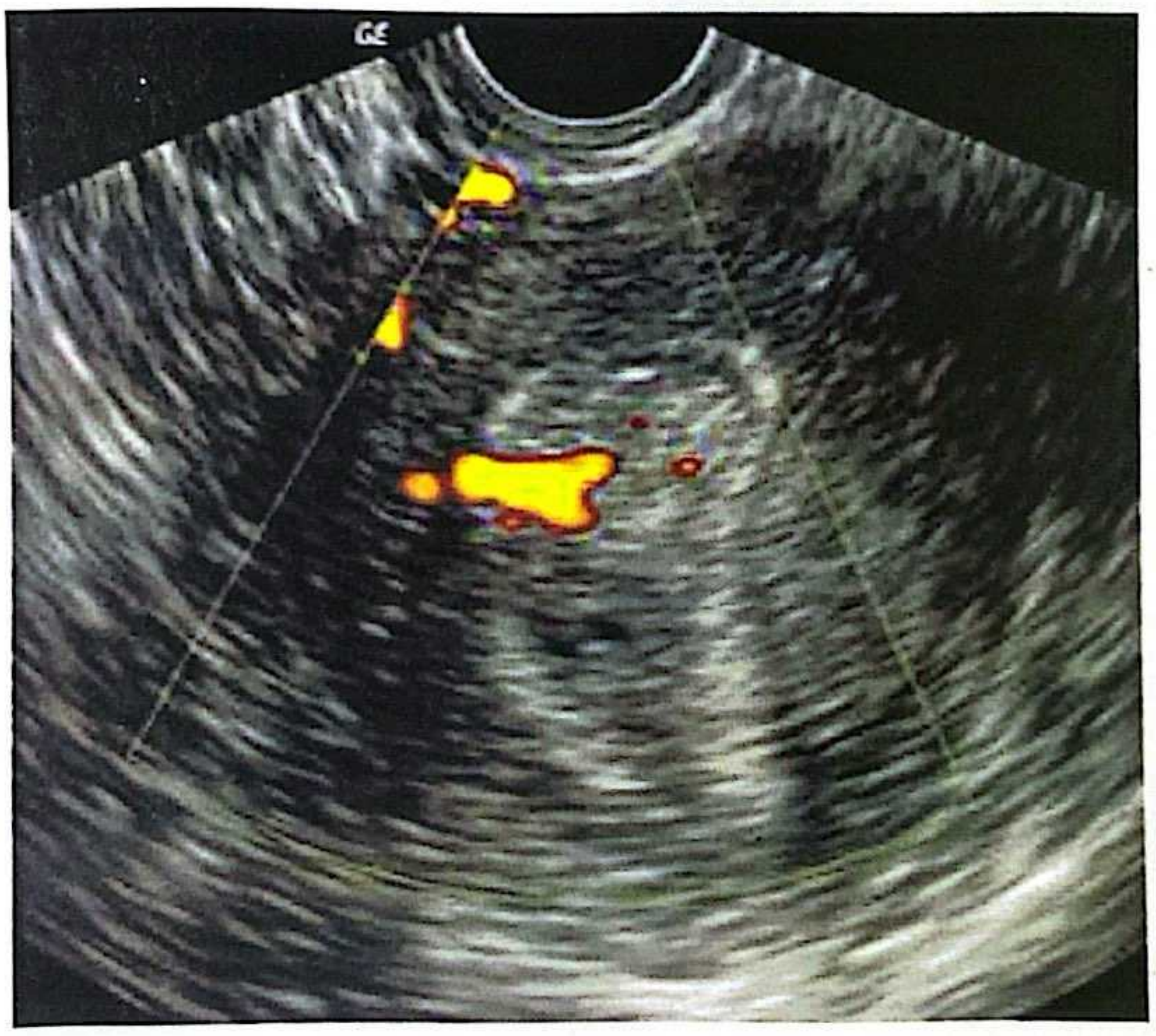
- uterus didelphys: complete failure of fusion occurs during the development of the paramesonephric ducts with duplication of the uterus, cervix and vagina
- septate uterus: has a normal fundal contour but is characterised by a persistent longitudinal septum that partially divides the uterine cavity



Two diverging endometrial cavities are seen with increased intercornual distance. However, cervical canal appears to be single, with catheter bulb in cervix

Q.6) Primary infertility. **(2016), (2018)**





Identify: Transvaginal ultrasound showing grey scale and color doppler images of uterus

Describe:

1. A well-defined echogenic endometrial lesion with a vascular pedicle is noted
2. A broad-based stalk to the polyp seen

3. A feeding vessel seen extending to the polyp on colour Doppler image
4. Few small cystic spaces corresponding to dilated glands filled with proteinaceous seen within the lesion

Diagnosis: Endometrial polyp

What next:

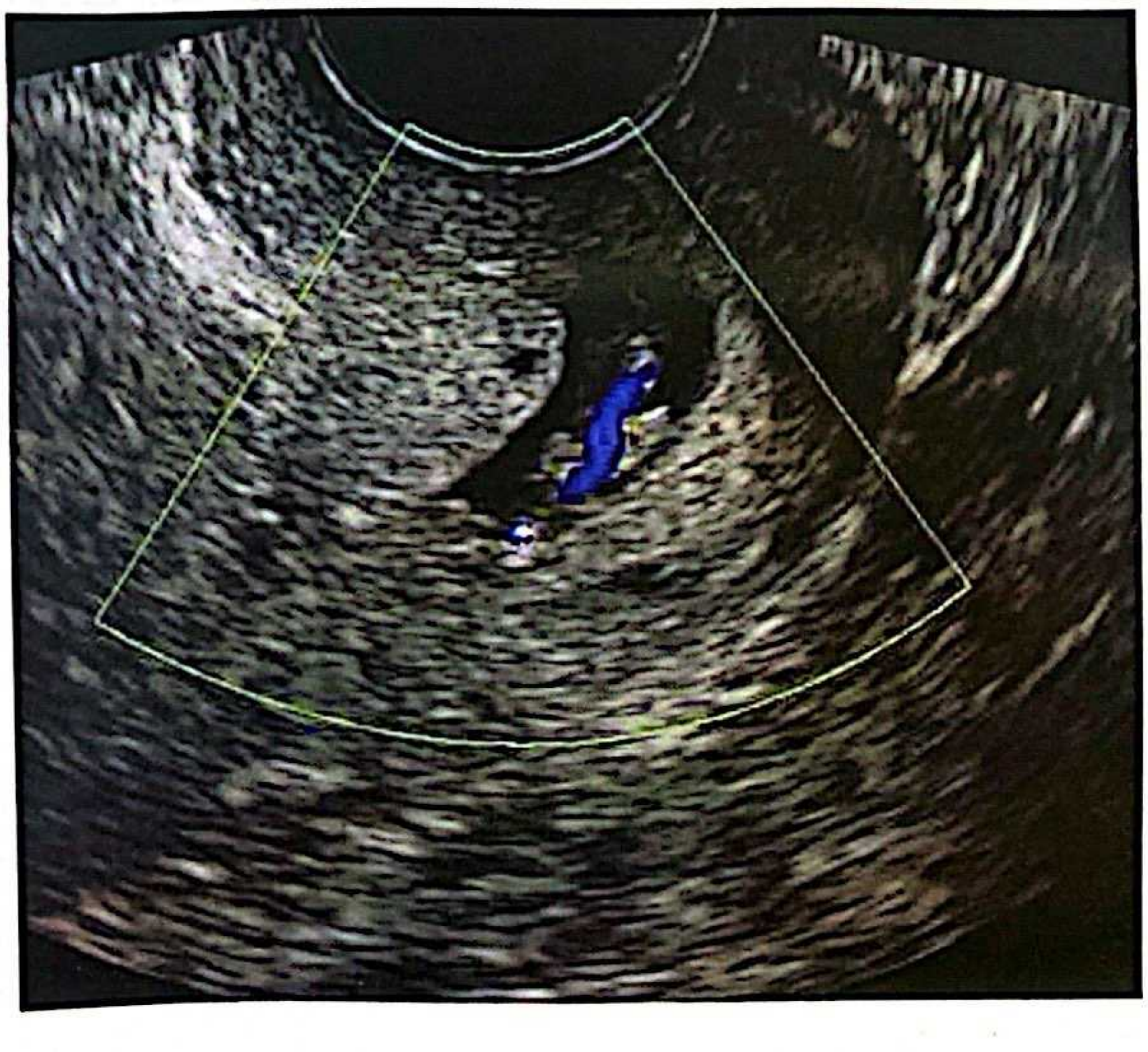
1. **3D ultrasound**
2. **Sonohysterography**
3. **Pelvic MRI**
   - T1: often isointense signal to endometrium
   - T2: endometrial polyps are often seen as hypointense intracavitary masses surrounded by hyperintense fluid and endometrium
   - T1 C+ (Gd): can show either homogeneous or heterogeneous enhancement
4. **Hysterosalpingography (HSG)**
   - Polyps may be seen as pedunculated or sessile filling defects within the uterine cavity.

Treatment:

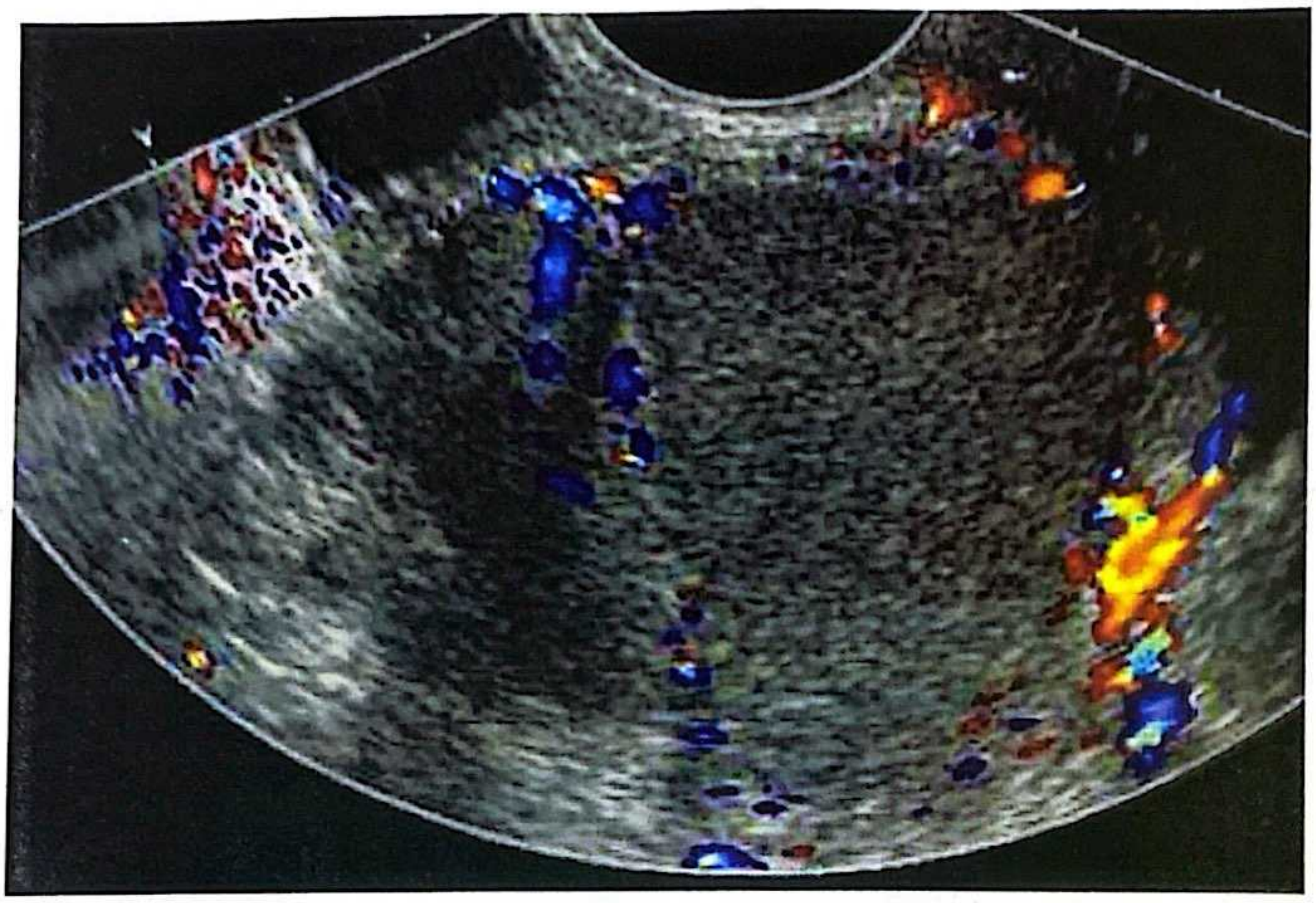
Polypectomy

Differential diagnosis:

1. Uterine leiomyoma(s)
2. Endometrial hyperplasia
3. Intrauterine blood clot
4. Retained products of conception



Polyp noted within the cervix. Vascular "stalk" noted on Doppler. Large left ovarian well defined cyst showing internal low level echoes, with no vascularity- Endometriosis



Pelvic protocol for endometriosis (MRI)

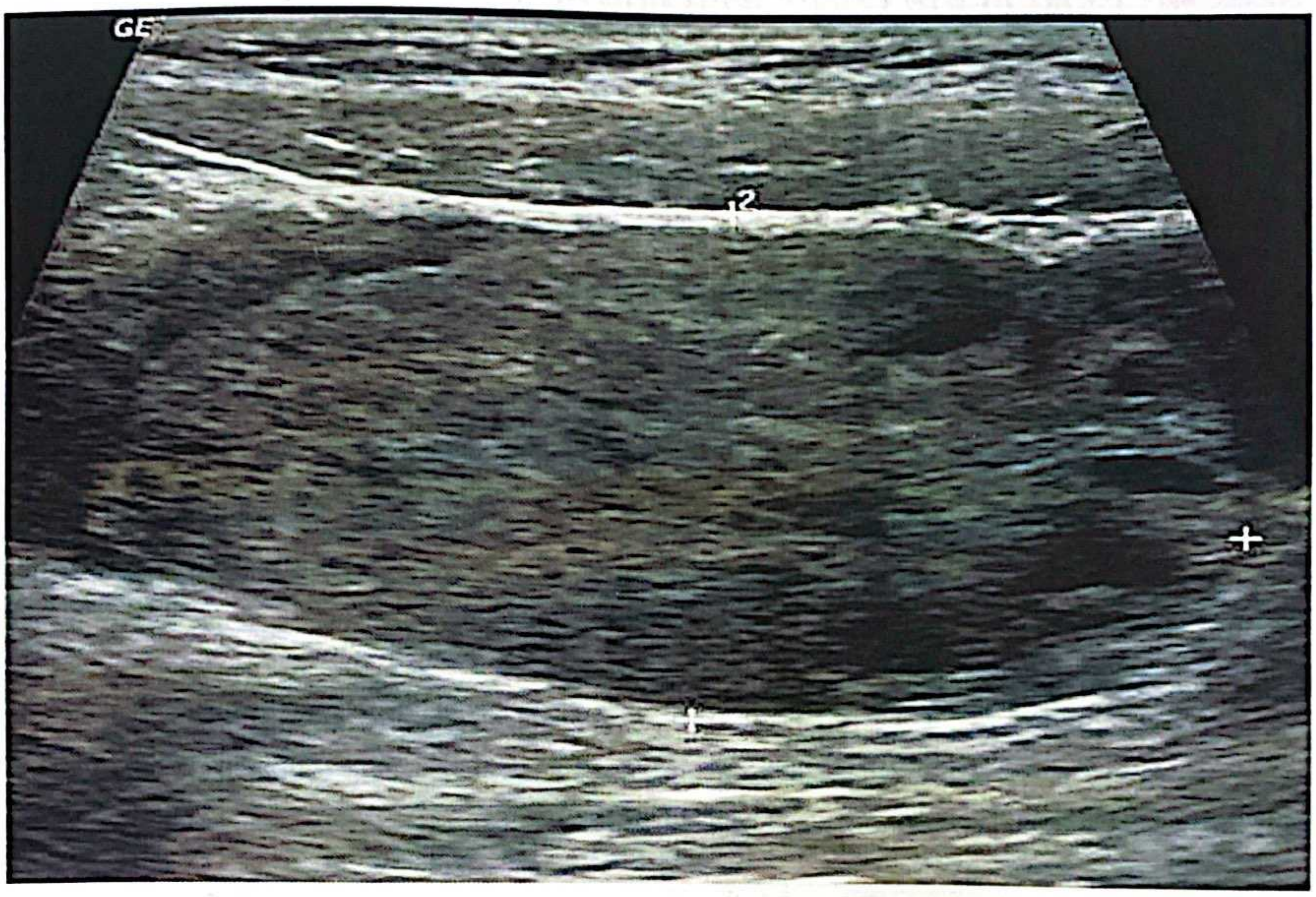
IV (or IM) Buscopan is administered to reduce bowel peristalsis and hence improve image quality.

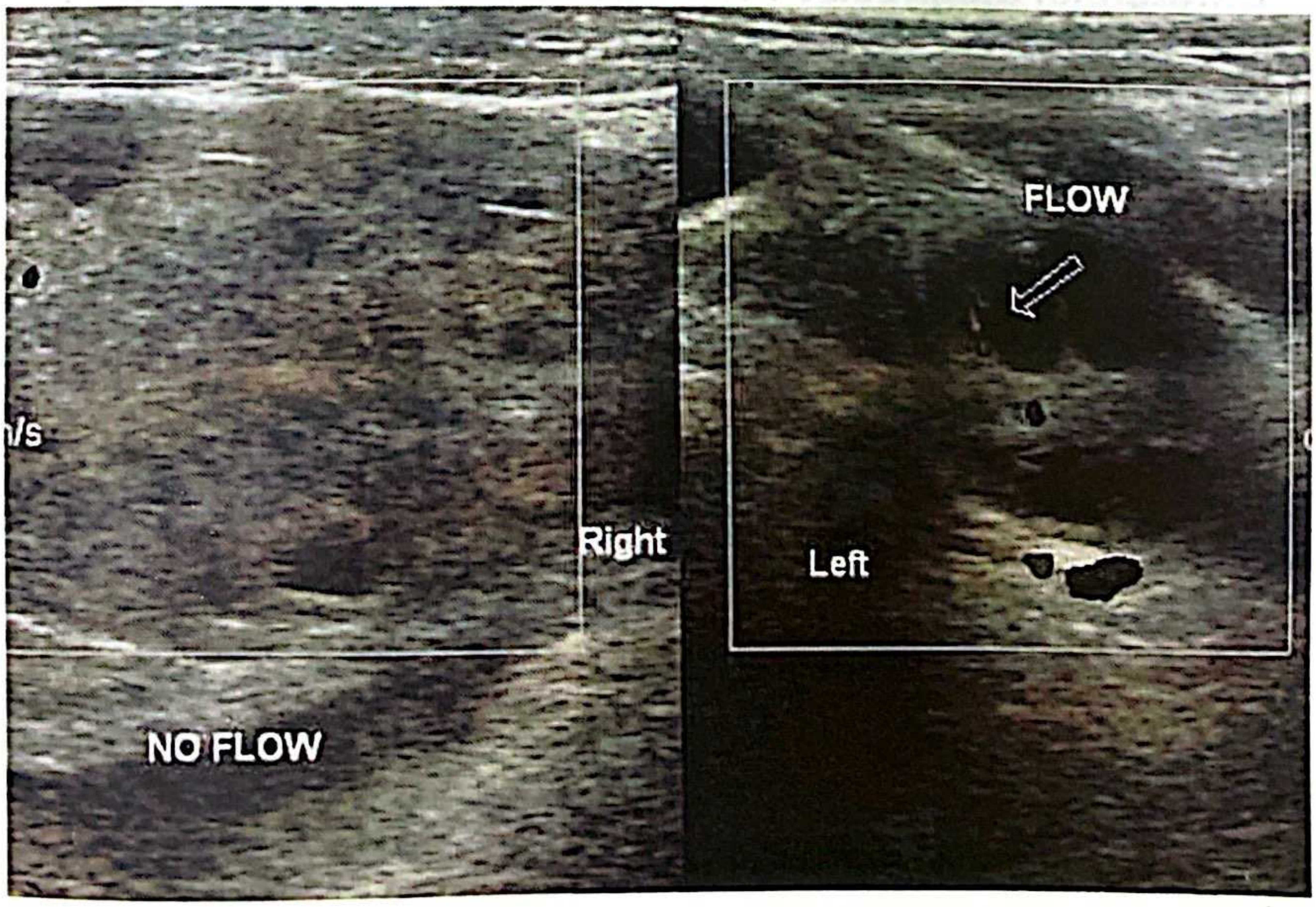
A good protocol involves:

- body coil
- T1W and T2W axial
- T1W fat-suppressed sequences 1: axial, sagittal and coronal
- Gadolinium is not particularly useful in the evaluation of endometriomas

Q.7) 8 yrs. Dull aching right flank pain - 3 days. No other complaints.

(2012)




/s
Right
NO FLOW
FLOW
Left

Identify: Ultrasound pelvis showing grey scale and color doppler transverse section images of ovaries

Describe:

1. Enlarged right ovary as compared to the left ovary
2. Enlarged right pedicle
3. Absent flow in right ovary with normal flow in left ovary
4. Fluid in the pelvis with tiny echoes

Diagnosis: Ovarian torsion

What next:

Treatment:

1. Urgent surgery is required to prevent ovarian necrosis.
2. In the case of a non-infarcted adnexa, surgical untwisting can be performed
3. Most ovaries are not salvageable in which case a salpingo-oophorectomy is required.

CT

- Good at ruling out ovarian torsion if a normal ovary/adnexa is seen on ultrasound

Complication:

If not removed the necrotic ovary can become infected and cause abscess or peritonitis.

Differential diagnosis:

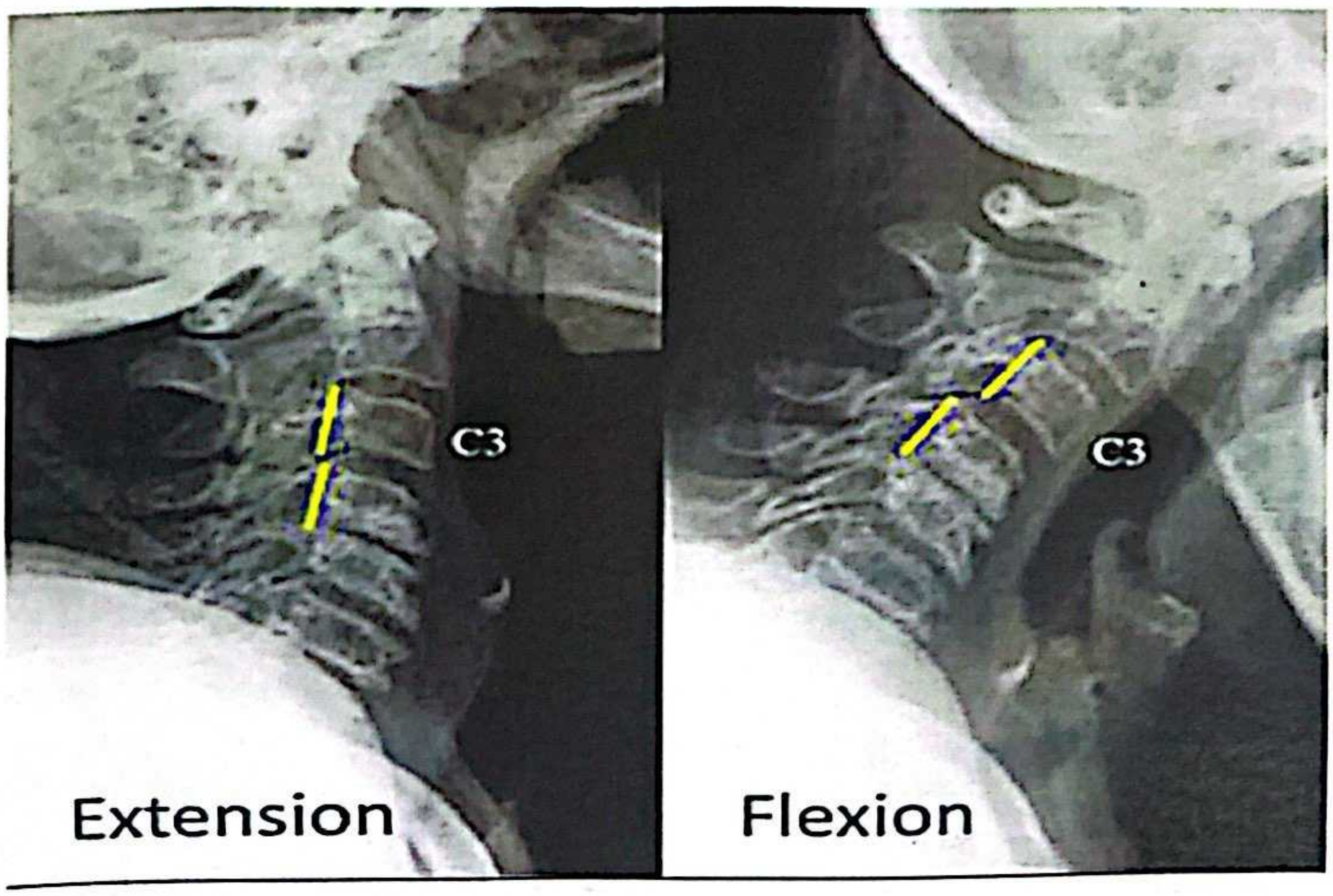
1. Pelvic inflammatory disease (PID): has a very different clinical presentation
2. Massive ovarian oedema (MOO)
3. Oophoritis

Important Points:

- The ovary should be tender to transducer pressure
- An absence of ovarian Doppler flow is highly specific for torsion, but normal Doppler flow does not completely exclude torsion
- An ovarian mass causing the torsion must always be sought

POSITIONING

Q.1) Identify? **(2017), (2015)**



Identify the view: Plain Radiographs of Cervical spine flexion-Extension lateral views

Positioning:

1. The patient is erect, left side against the upright detector
2. The detector is placed portrait, parallel to the long axis of the cervical spine on the patients left the side
3. The patient will have the neck in the extended (chin up) or flexion (chin down) position depending on the projection

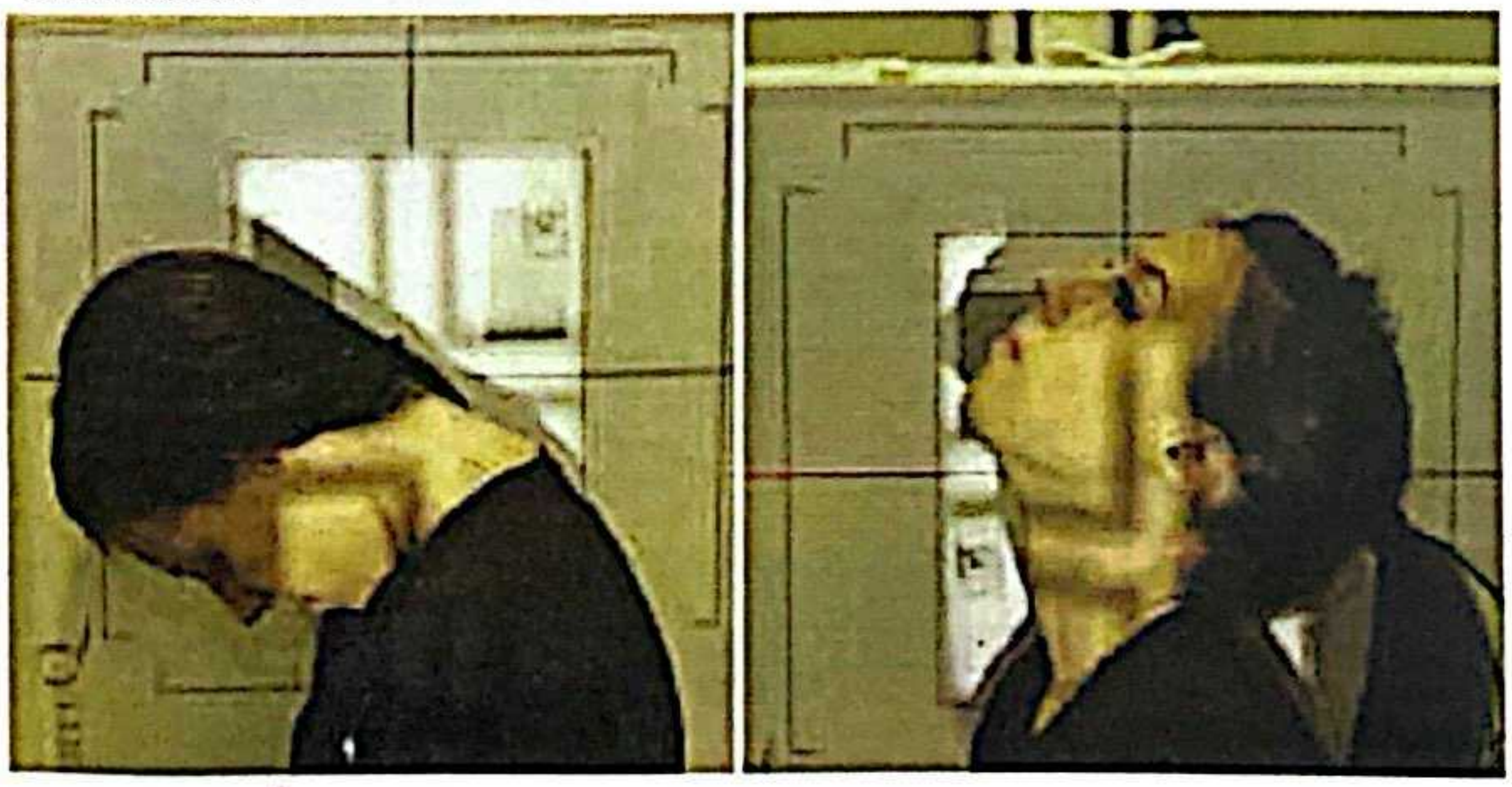
Centring: 2.5 cm above the jugular notch at the level of T1

Indications:

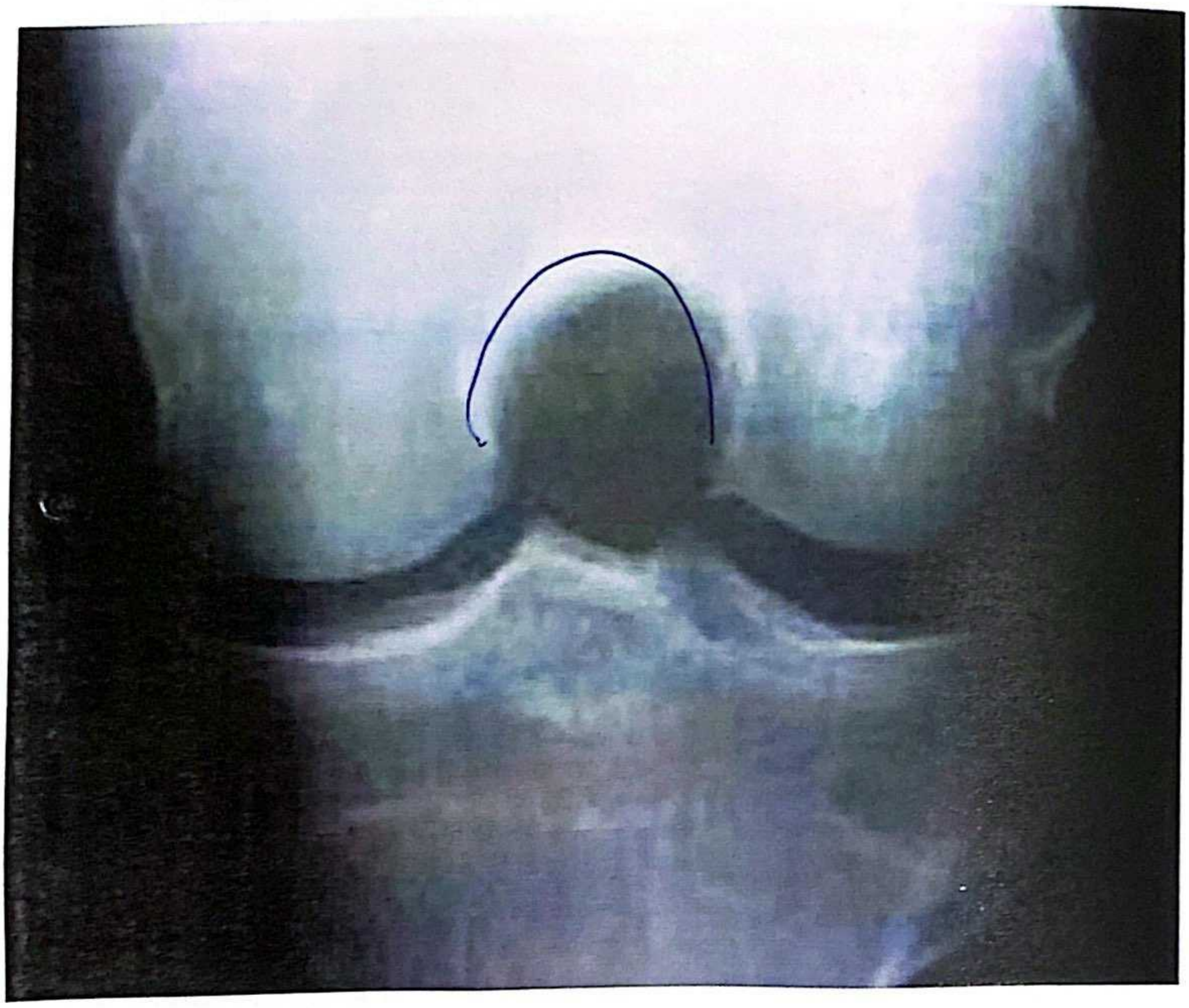
1. Instability of the os odontoideum
2. Odontoid fracture

Contraindications:

Cervical spine flexion-extension lateral views should not be performed on trauma patients without strict instructions of a qualified clinician

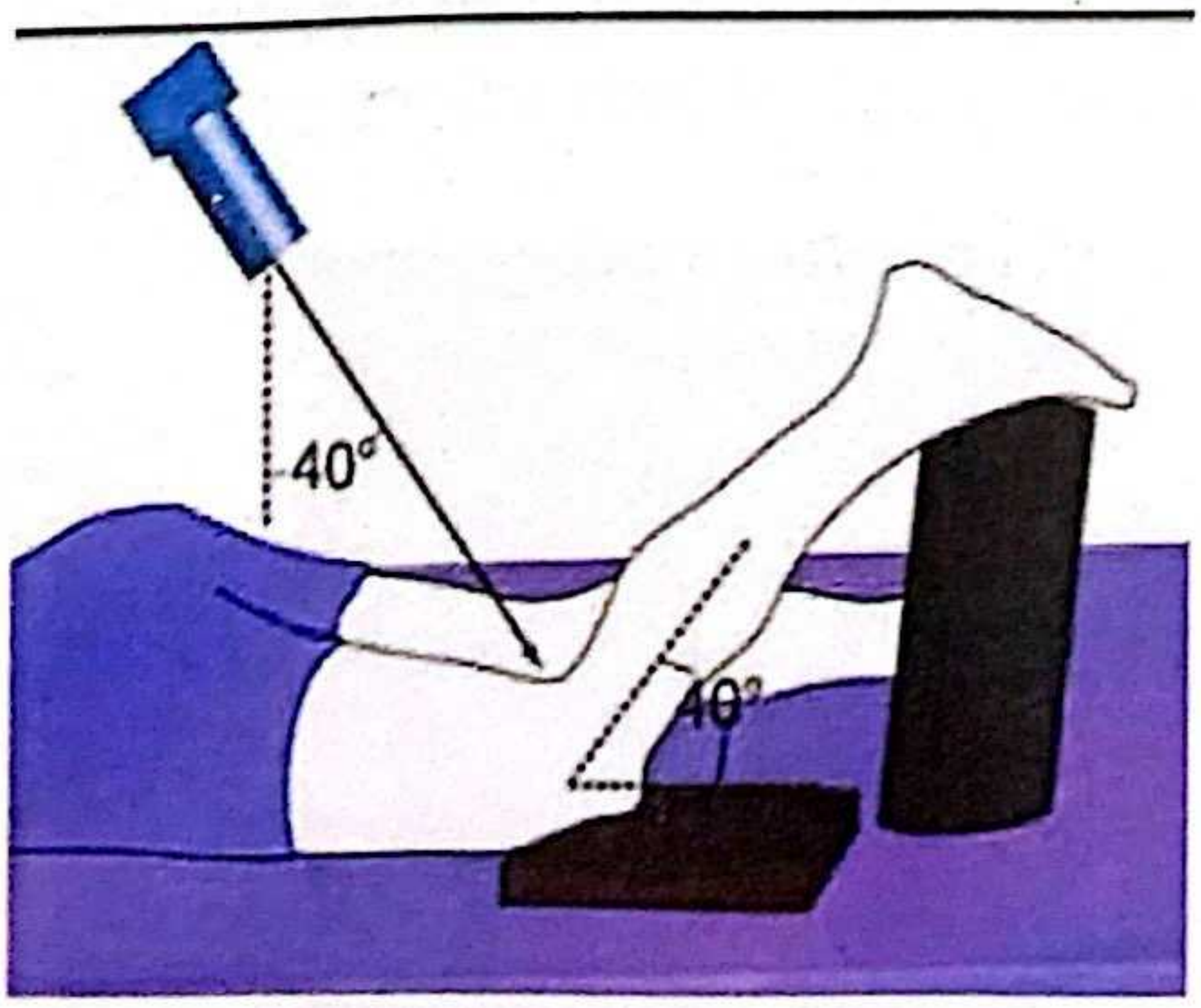


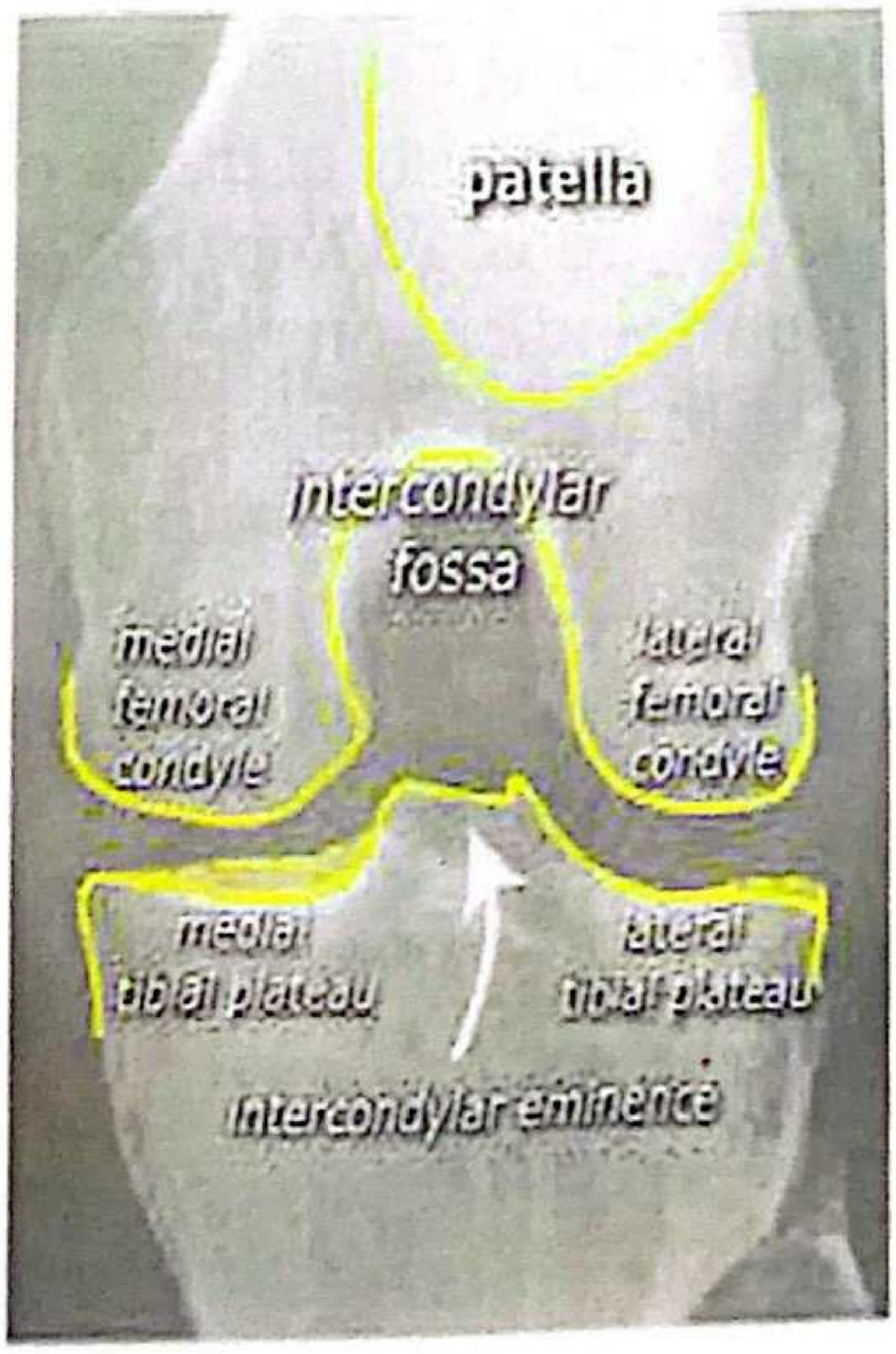
Q.2) Identify? **(2017)**



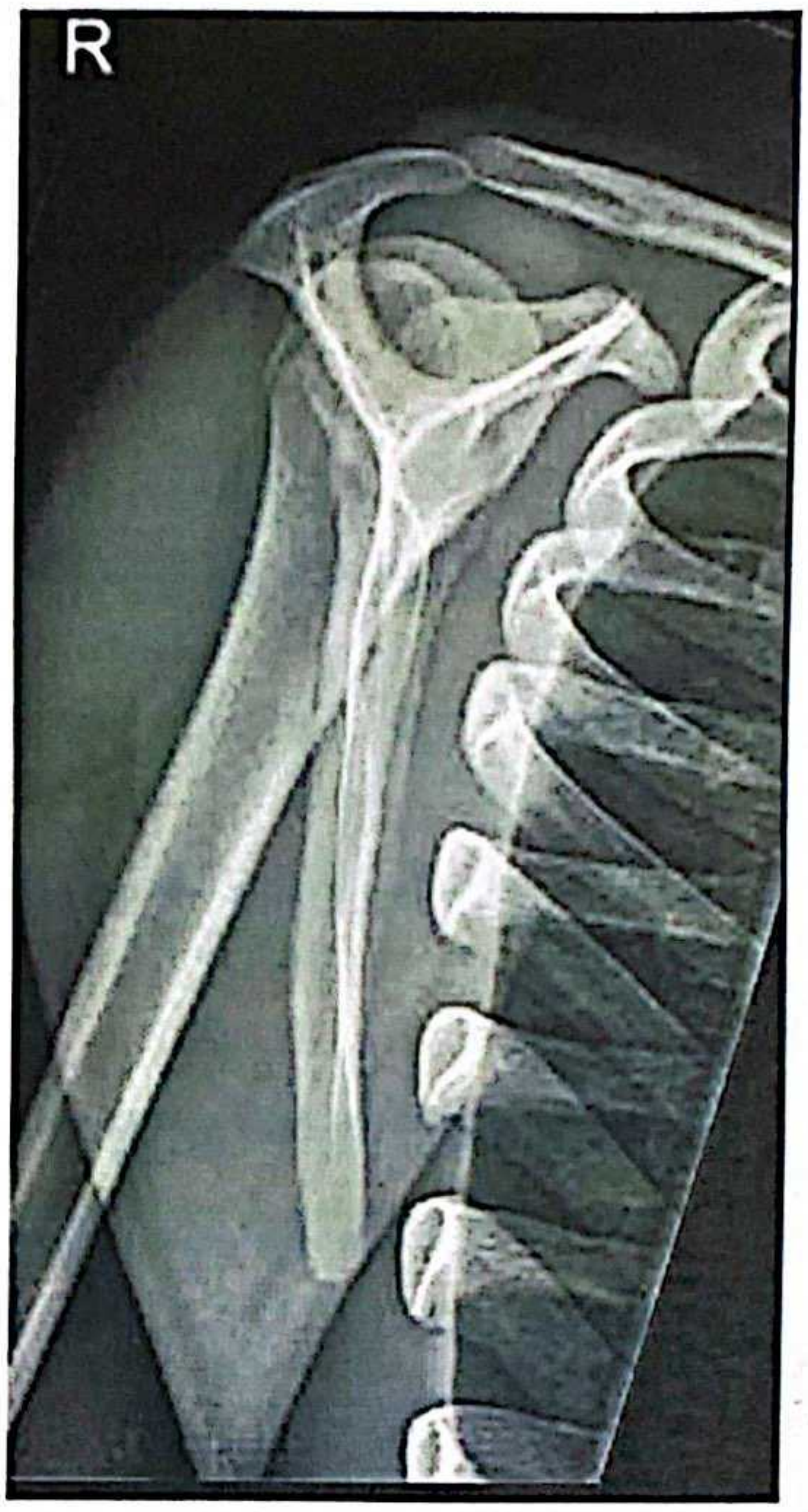
Identify the view: Radiograph Knee tunnel view
Positioning: Prone, flex knee untill leg froms 40^0 with table
Centring: 40^0 caudal angulations to enter posterior surface of knee ½ inch below patellar apex
Indications:

1. Intercondylar foramen
2. Tibial spines
3. Osteochondral lesions




patella
intercondylar fossa
medial femoral condyle
lateral femoral condyle
medial tibial plateau
lateral tibial plateau
intercondylar eminence

Q.3) Identify? **(2017)**



Identify the view: Lateral scapula shoulder or Y view

Positioning:

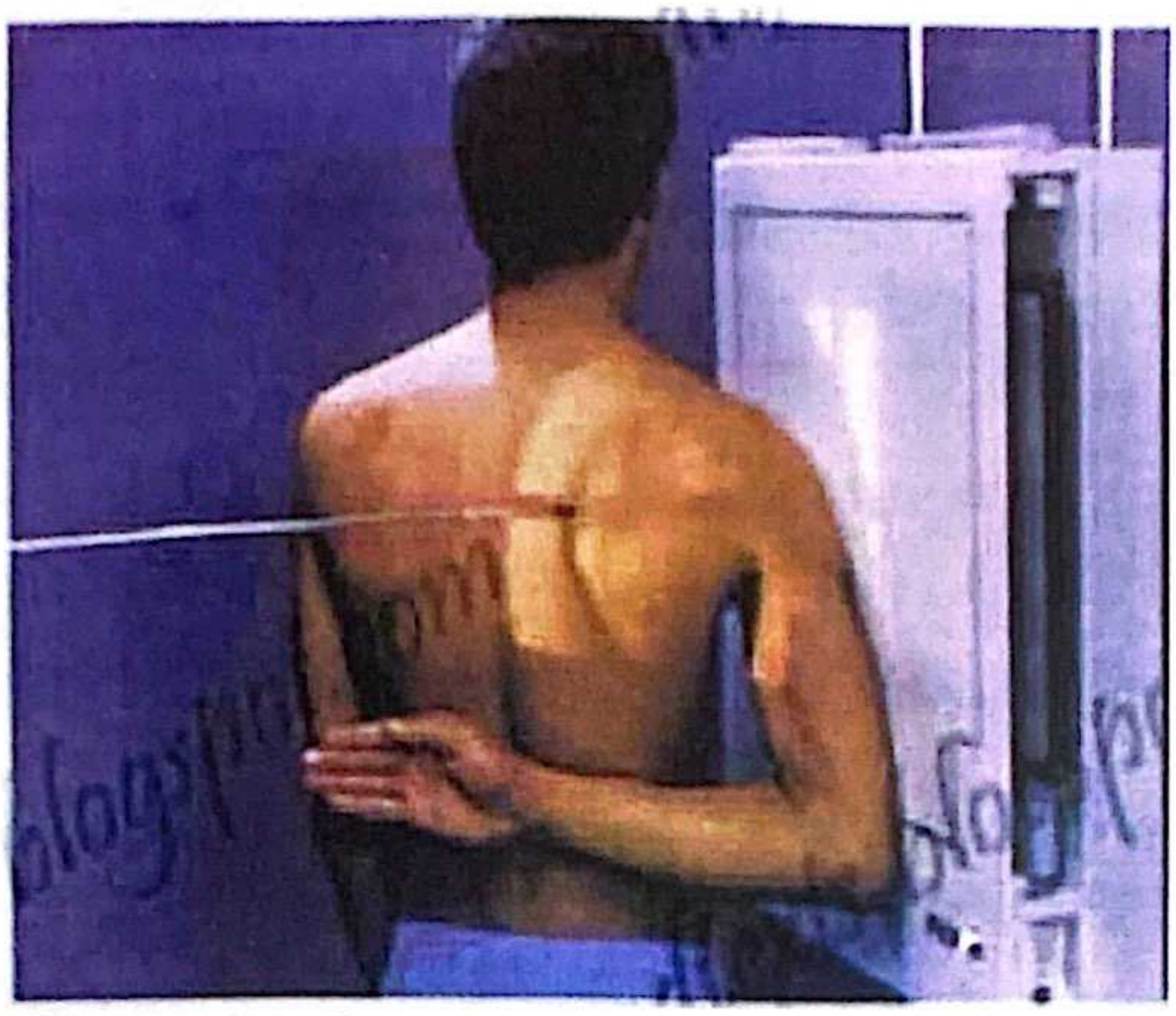
1. Erect or sitting, facing the upright Detector/Grid
2. Affected arm in midline of Detector/Grid
3. Body rotated in an anterior oblique 60° position so the anterior portion (Humeral head) of the shoulder is touching the upright Detector/Grid
4. The hand is placed on the patient's abdomen or back with the arm flexed
5. Degree of anterior rotation can vary from patient to patient
6. Scapula should be end-on to the upright detector, and this can be done via palpation of the scapula border

Centring:

1. Perpendicular to shoulder joint (5cm below top of shoulder)
2. Central to the medial scapula border

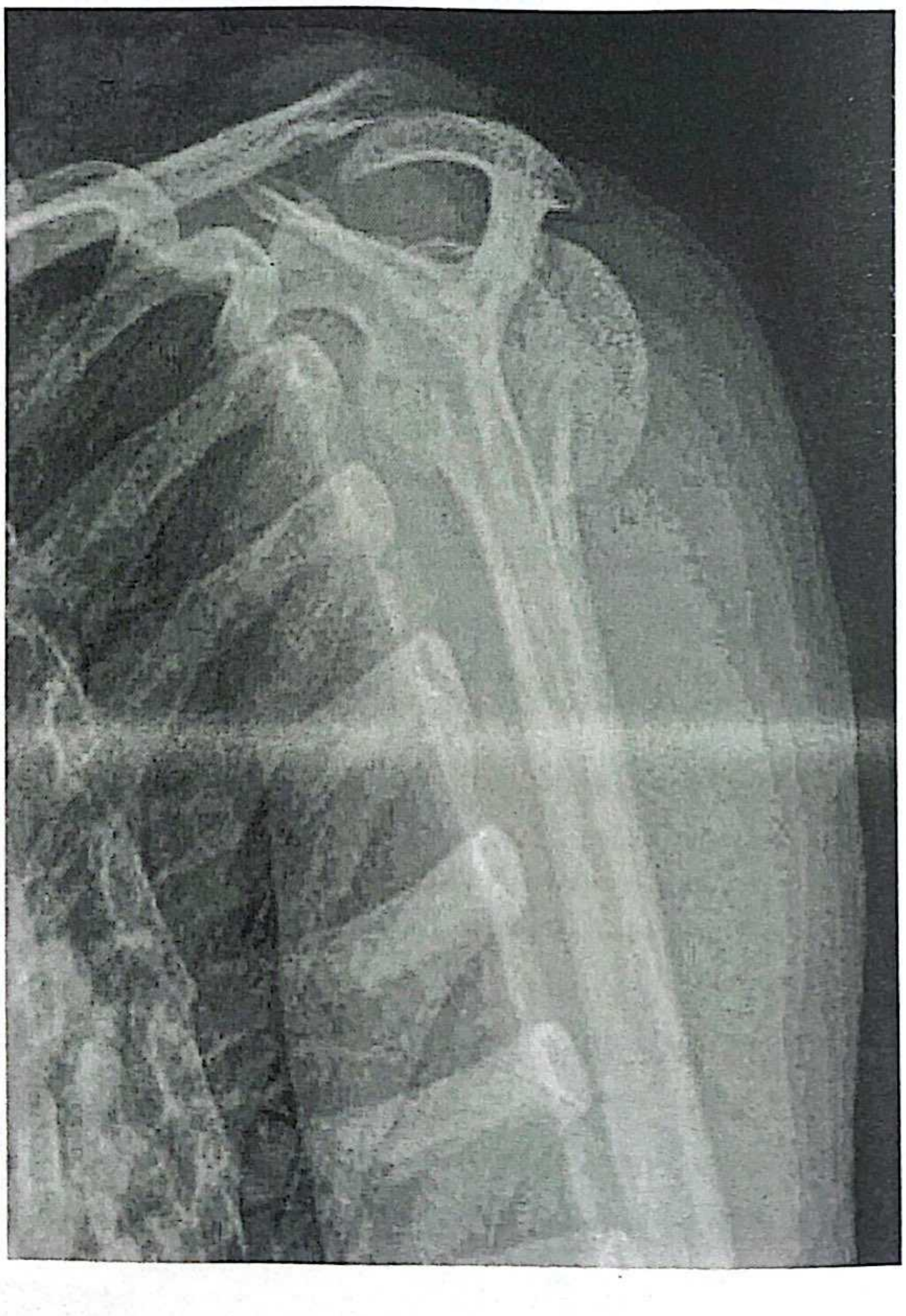
Indications:

1. Shoulder Dislocations
2. Scapula fractures
3. Degenerative changes

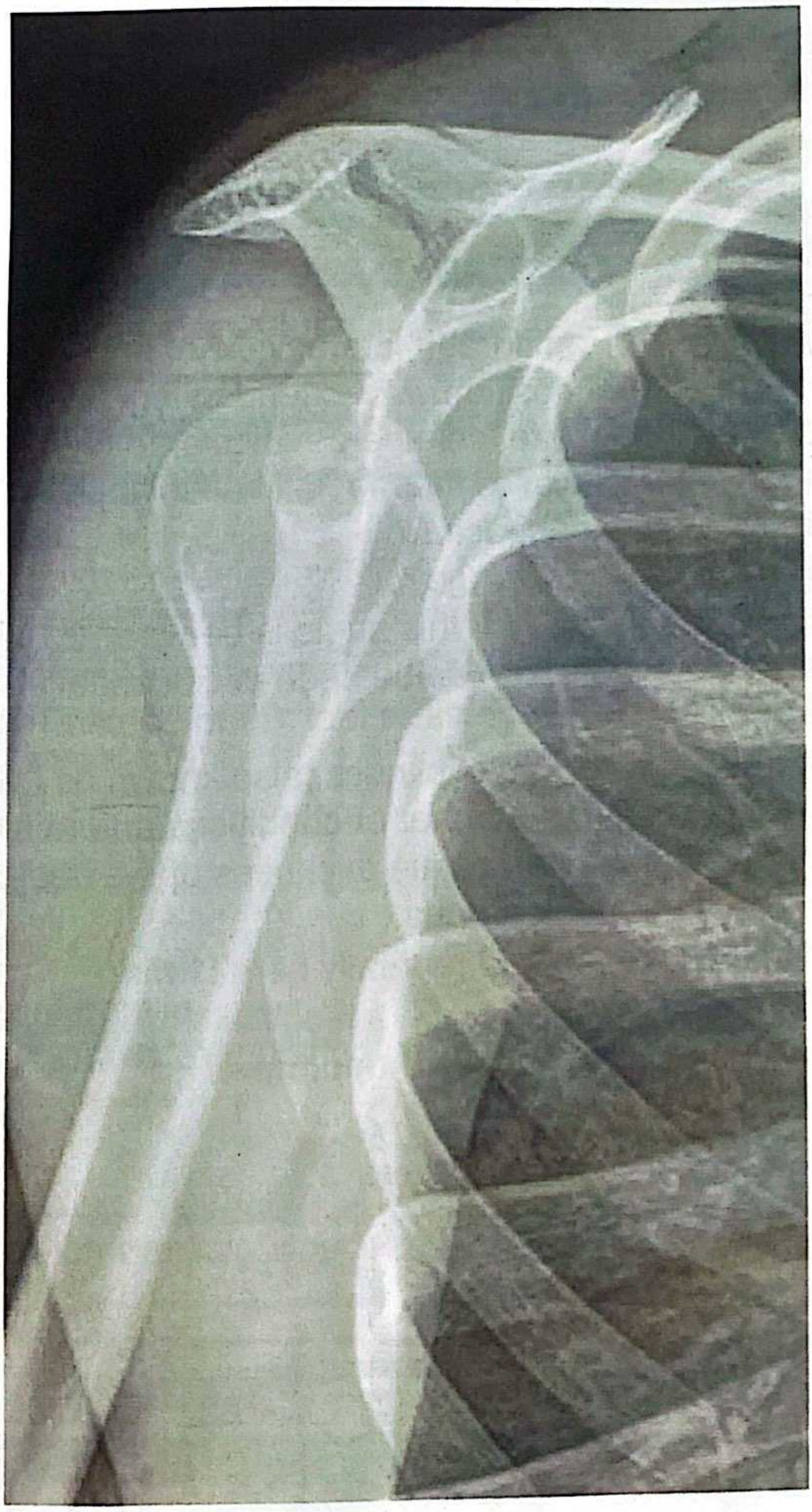


Comminuted fracture of the proximal humerus with posterior dislocation of the humeral head.

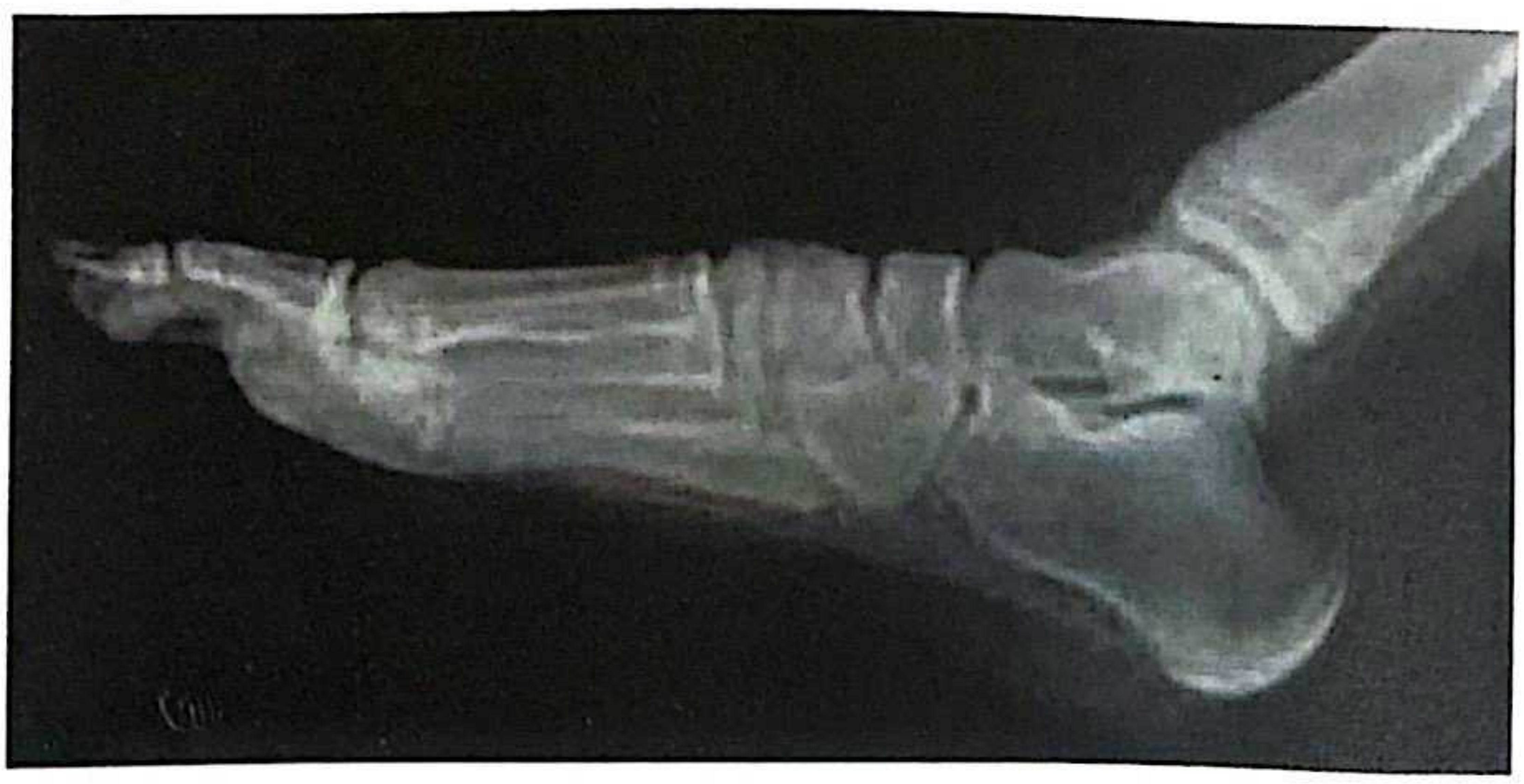
Head Near to coracoid process



Humeral head is inferiorly dislocated. No fracture identified.
Note humeral alignment parallel to the chest wall.
Head Away from coracoid process



Q.4) Identify? **(2017), (2015)**



Identify the view: Radiograph lateral view of ankle joint
Positioning: Lateral position with extended leg, flex knee till patella perpendicular to cassette, sole perpendicular to cassette
Centring: Perpendicular to the medial malleolar prominence
Indications: Calcaneal fracture.

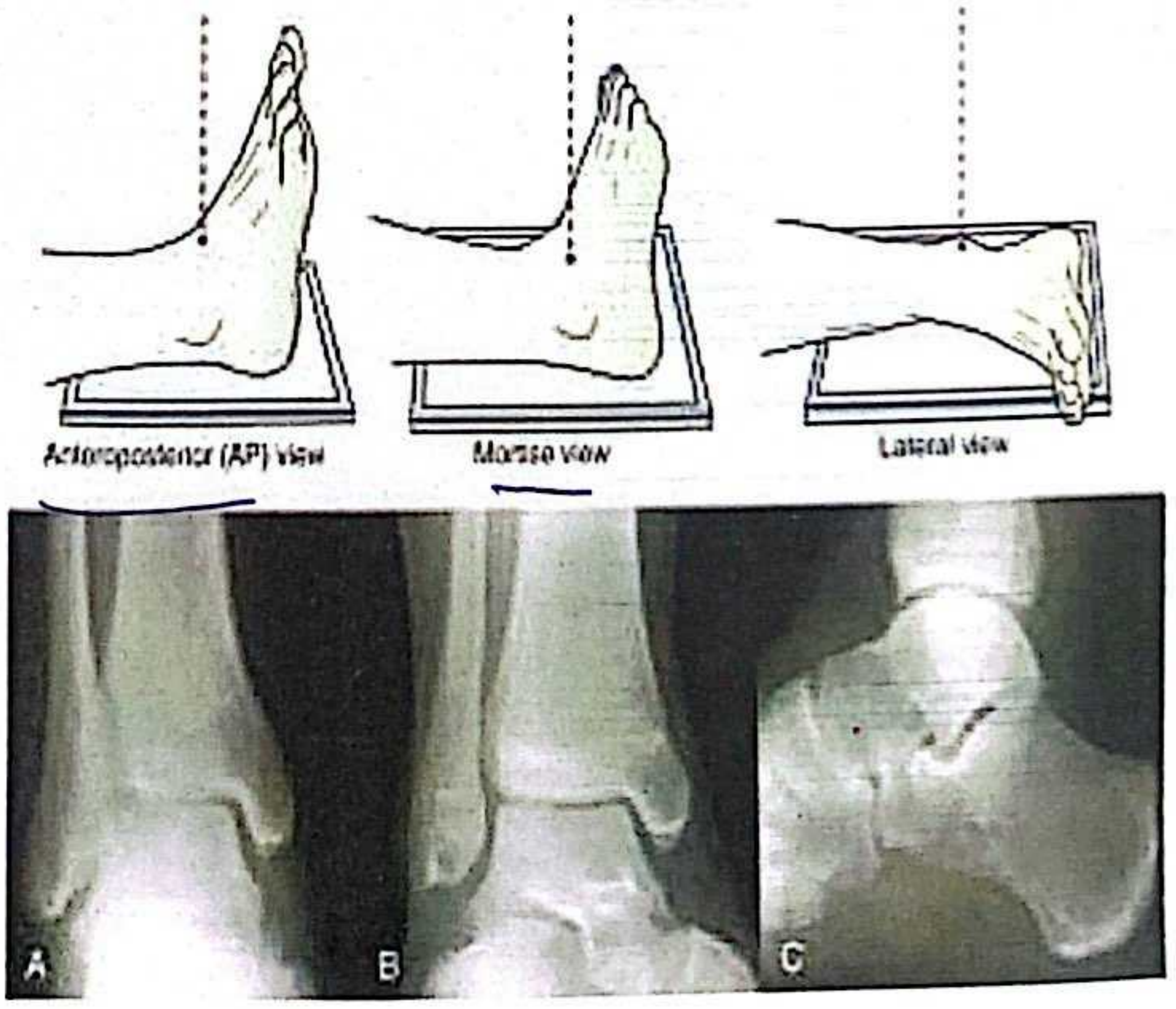
Normal Bohlers angle range?

- The normal value for this angle is between 20° to 40°. A value less than 20° can be seen in calcaneal fracture.

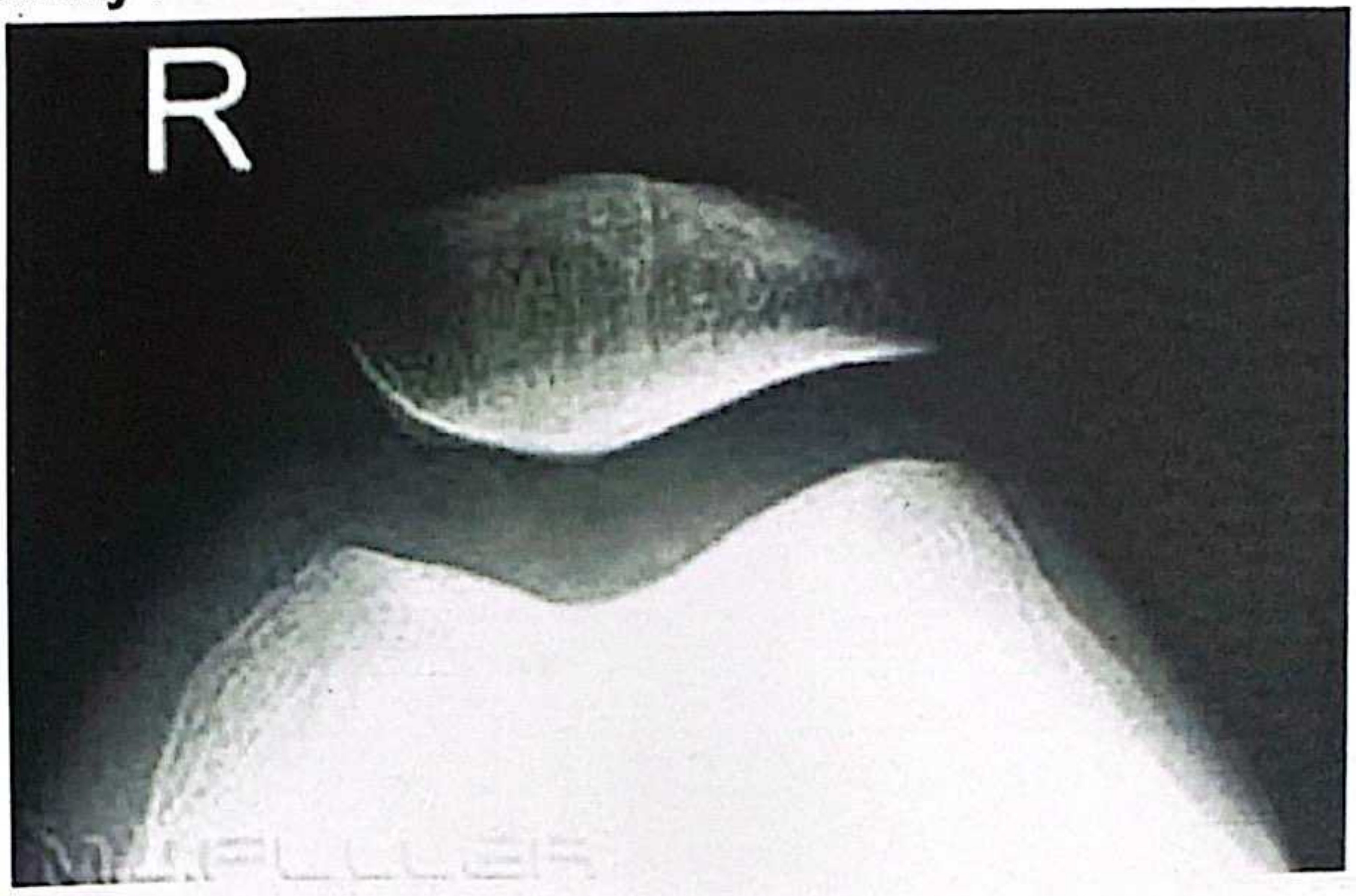
Normal Heel pad range?

- Increased heel pad thickness, also known as the heel pad sign, is seen in a number of conditions and relates to an increase in the soft-tissue thickness of the heel pad on lateral ankle radiographs.
- The heel pad should normally be <21 mm
- Range 10 to 15mm

Causes of increased heel pad thickness is:
MAD COP
Mnemonic
M: myxoedema
A: acromegaly
D: phenytoin therapy
C: callus
O: obesity
P: peripheral oedema



Q.5) Identify? **(2016)**



Identify the view: Patella skyline/Sunrise view

Positioning:

- Settegast: Knee flexion 90° Prone, flex knee 90°, hold foot with gauze
- Hughston: Knee flexion 55° Same as settegast but 55° knee flexion instead of 90, foot rests on collimator

Technique:

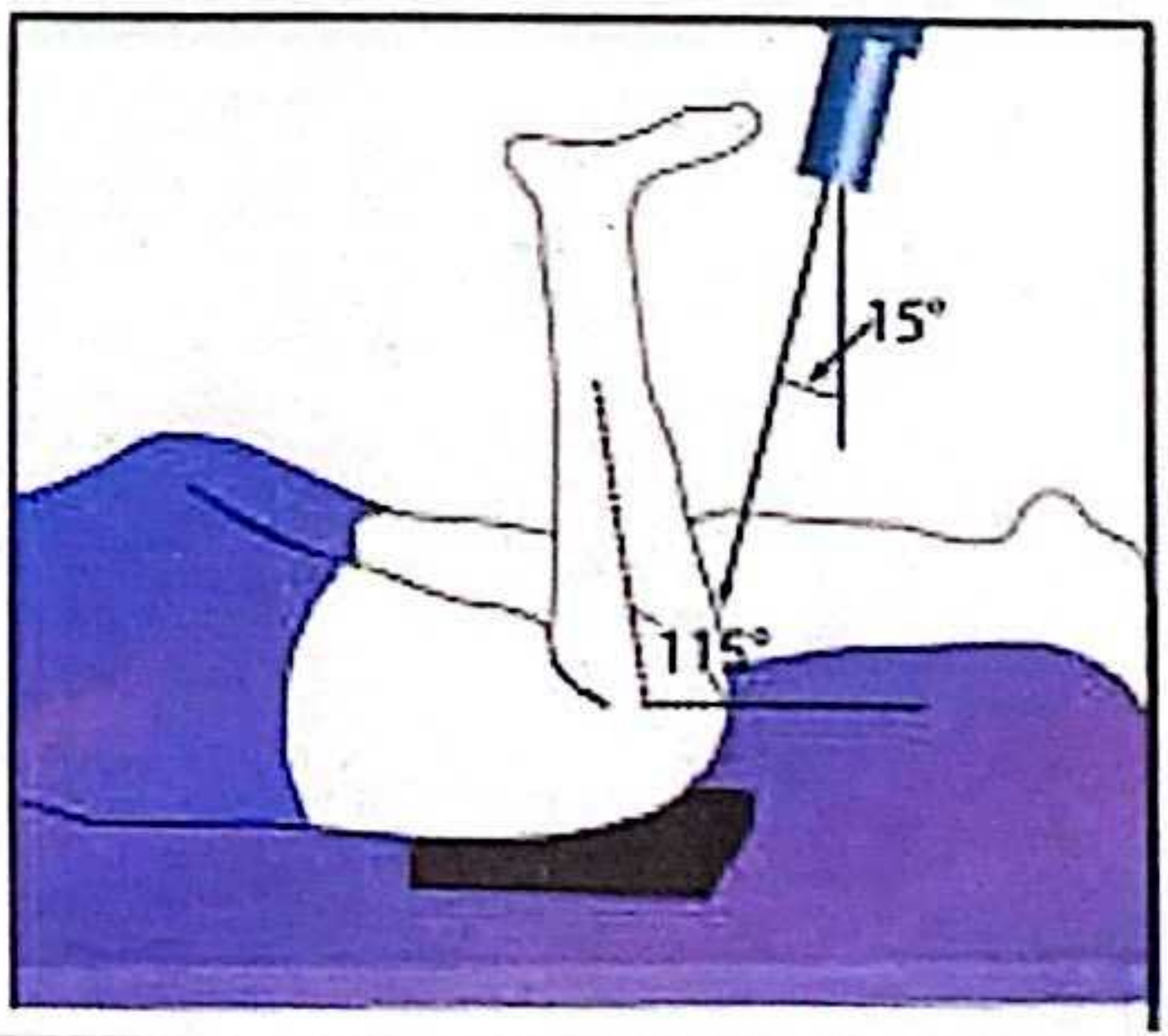
1. Conventional inferosuperior
2. Superoinferior
3. Prone inferiosuperior

Centring:

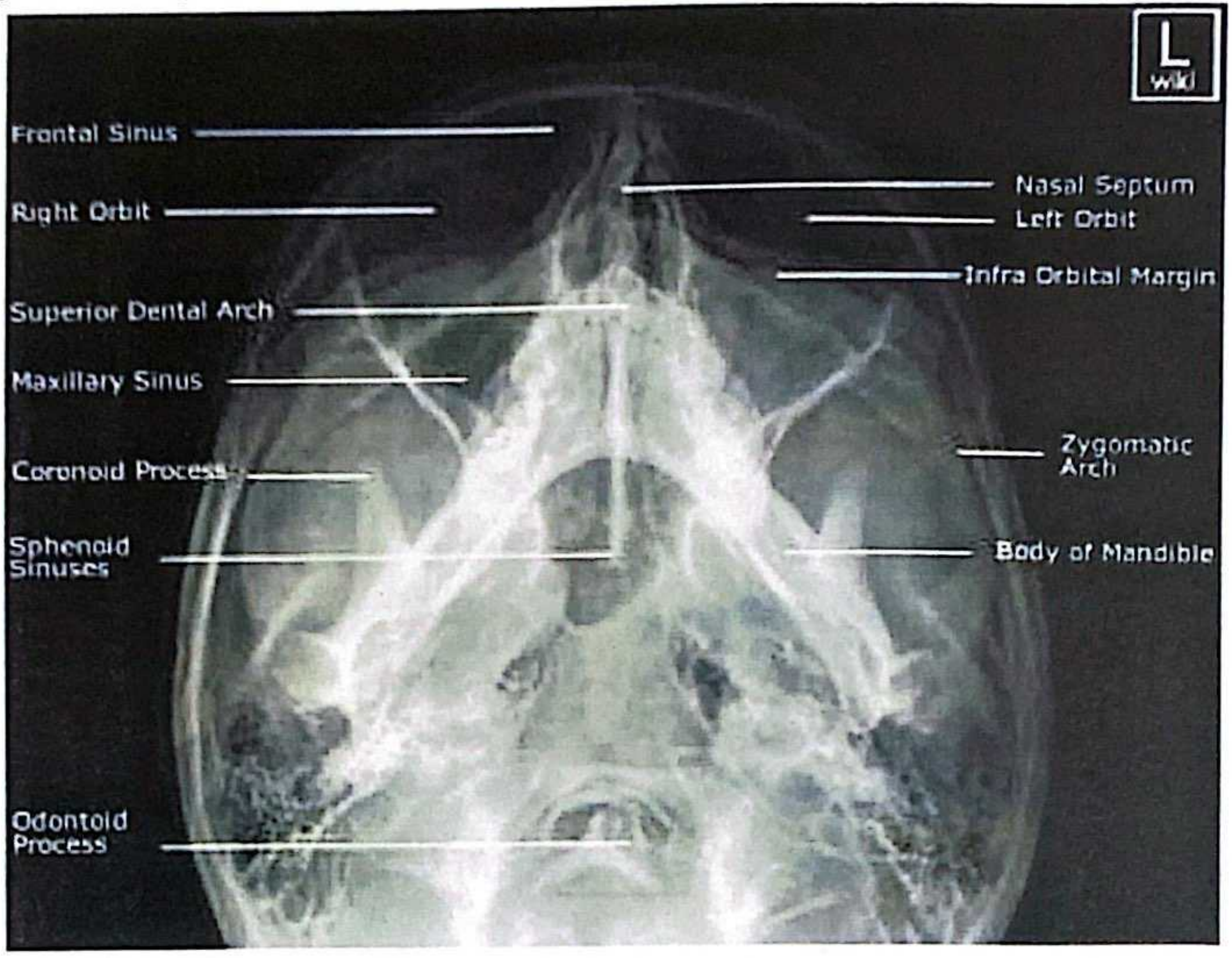
1. Apex of patella
2. 20° downward angulation passing through femoropatellar joint space for both

Indications:

1. Dislocation of patella
2. Patellofemoral joint space
3. Vertical patellar fracture in acute trauma
4. Chondromalacea
5. Degree of Lateral subluxation



Q.6) Identify? (2015)


L
wiki
Frontal Sinus
Right Orbit
Superior Dental Arch
Maxillary Sinus
Coronoid Process
Sphenoid Sinuses
Odontoid Process
Nasal Septum
Left Orbit
Infra Orbital Margin
Zygomatic Arch
Body of Mandible

Identify the view: Radiograph Skull Submento-vertex Basal View

Positioning:

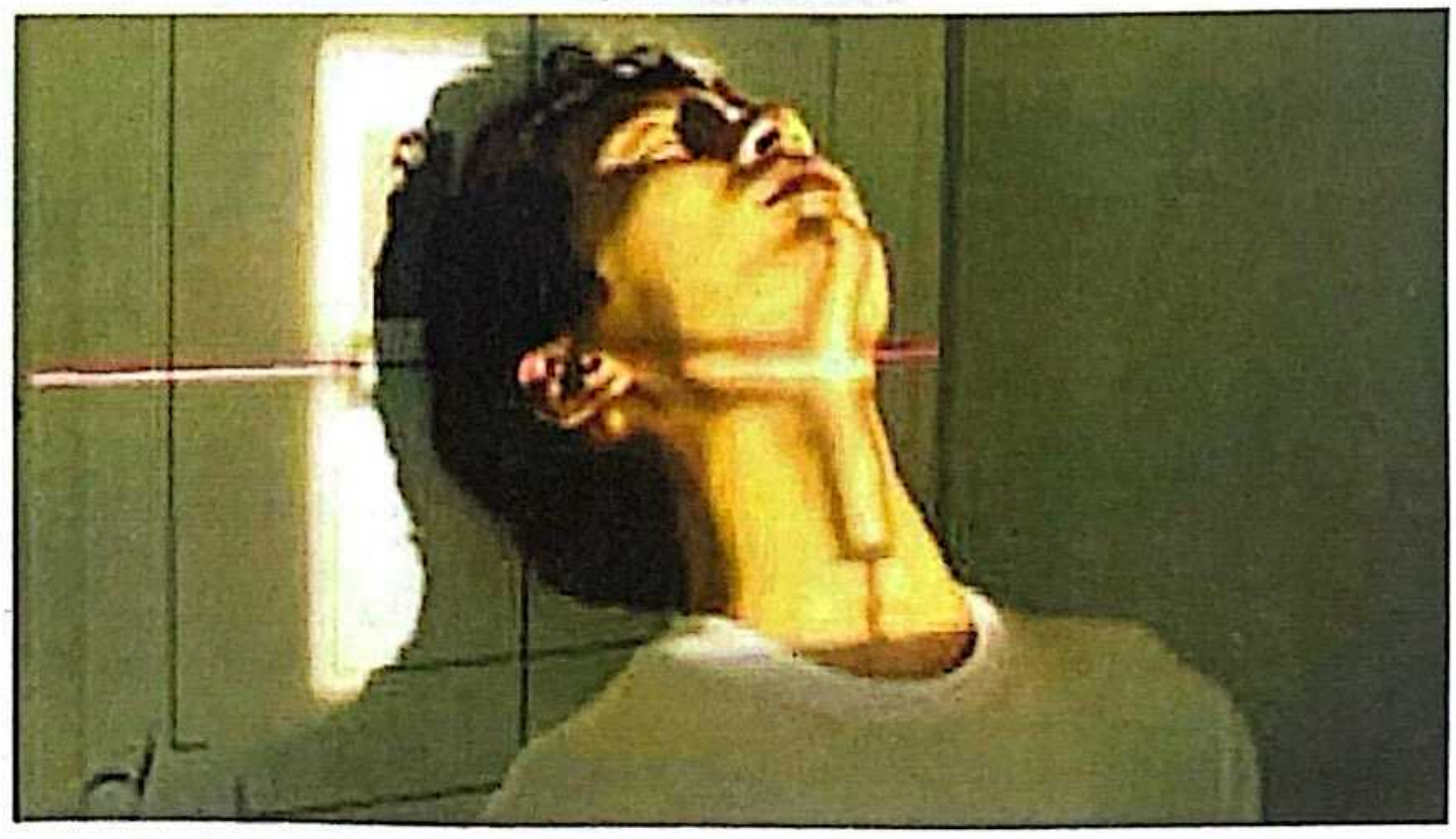
1. Supine, mid sagittal plane perpendicular to film
2. Infra orbitomeatal line parallel to film
3. Hyperextended neck
4. Rest head on vertex

Centring:

Perpendicular to infra- orbitomeatal line at point midway between angles of mandible or external auditory meatus to pass through sella turcica and exit at vertex

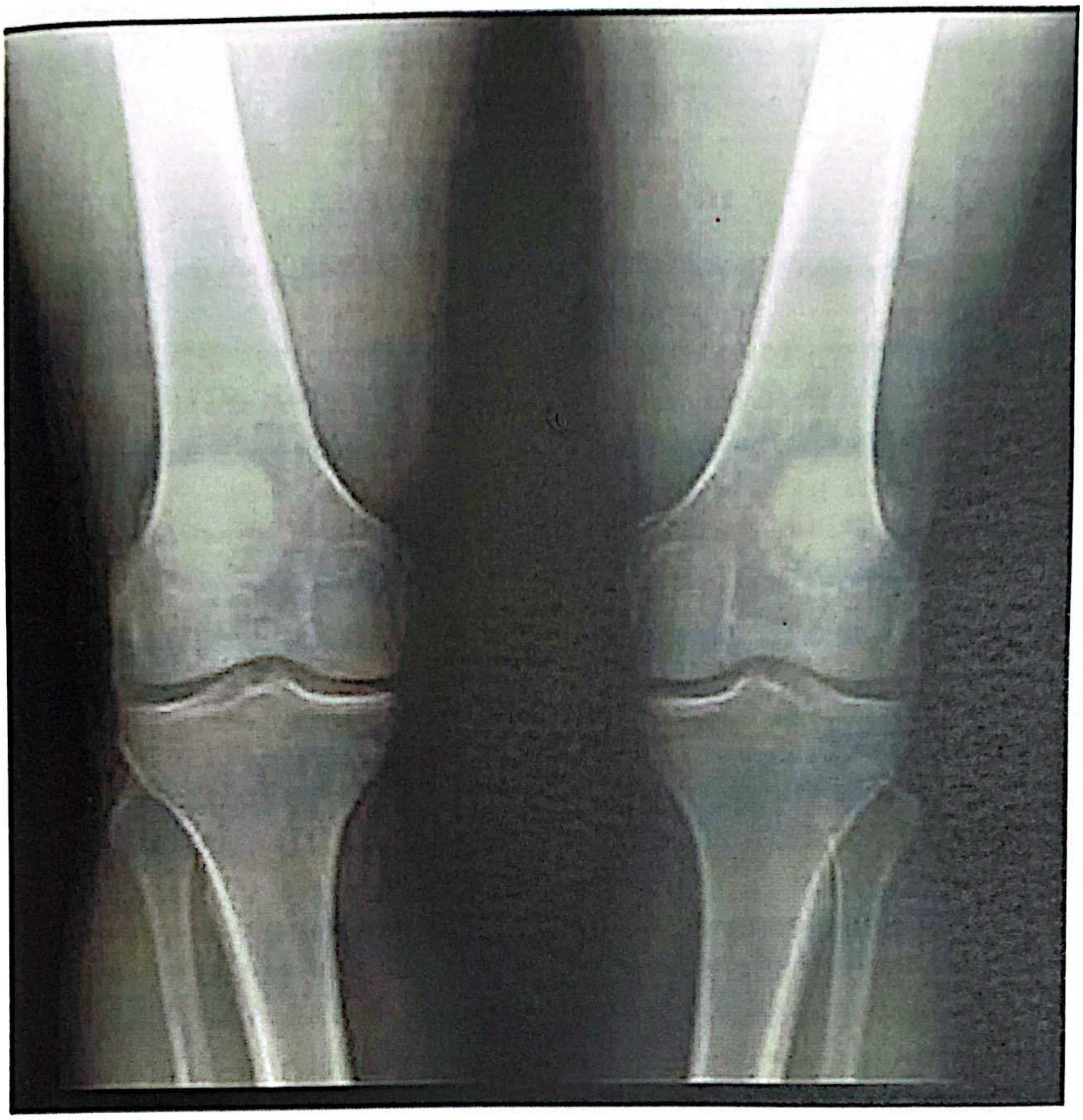
Indications:

- This view looks at the base of the skull like its fractures, including structures such as the foramen ovale, foramen spinosum, and sphenoid sinuses



ebank.pk

Q.7) Identify? **2014)**



Identify the view: Radiograph Knee AP weight-bearing view

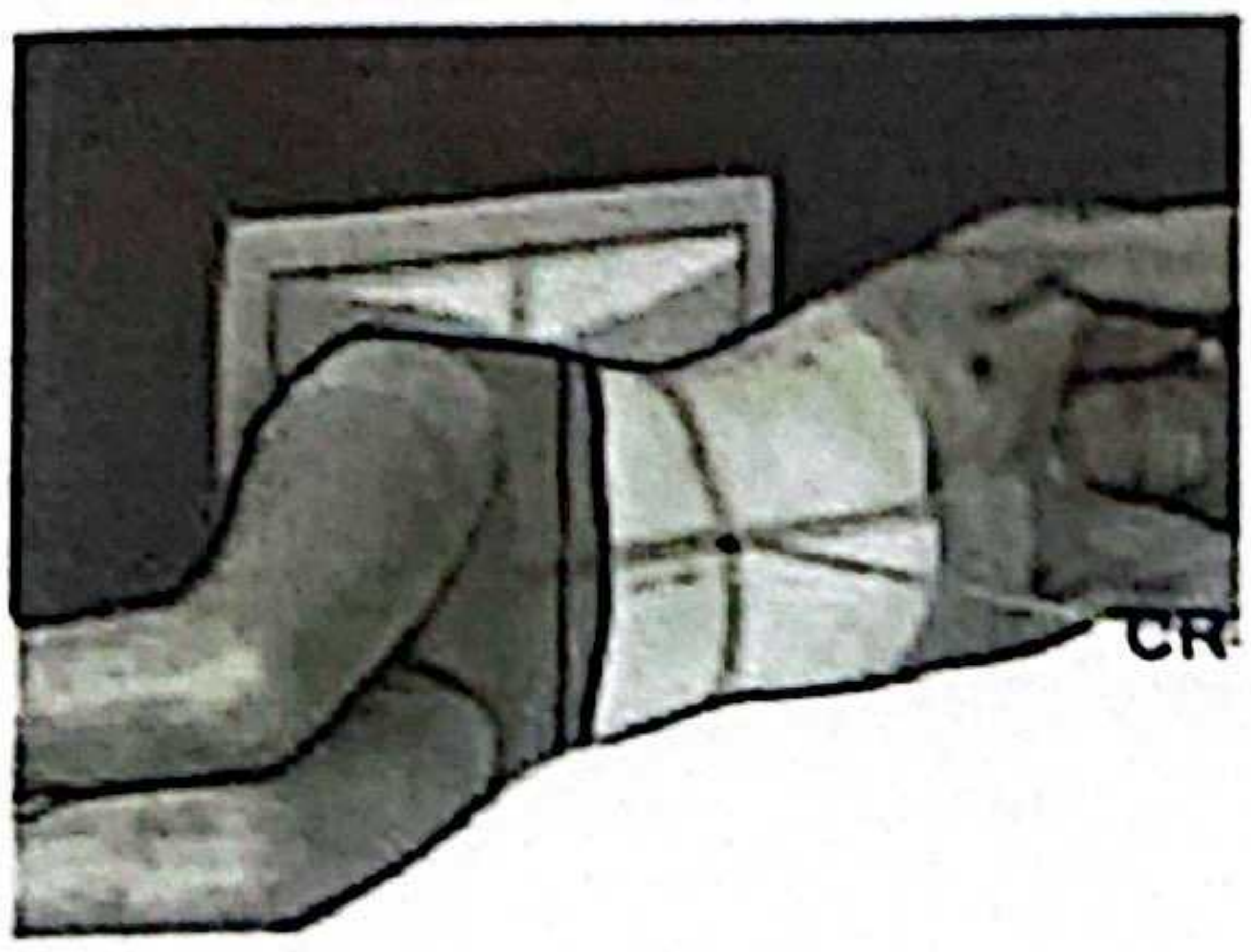
Positioning:

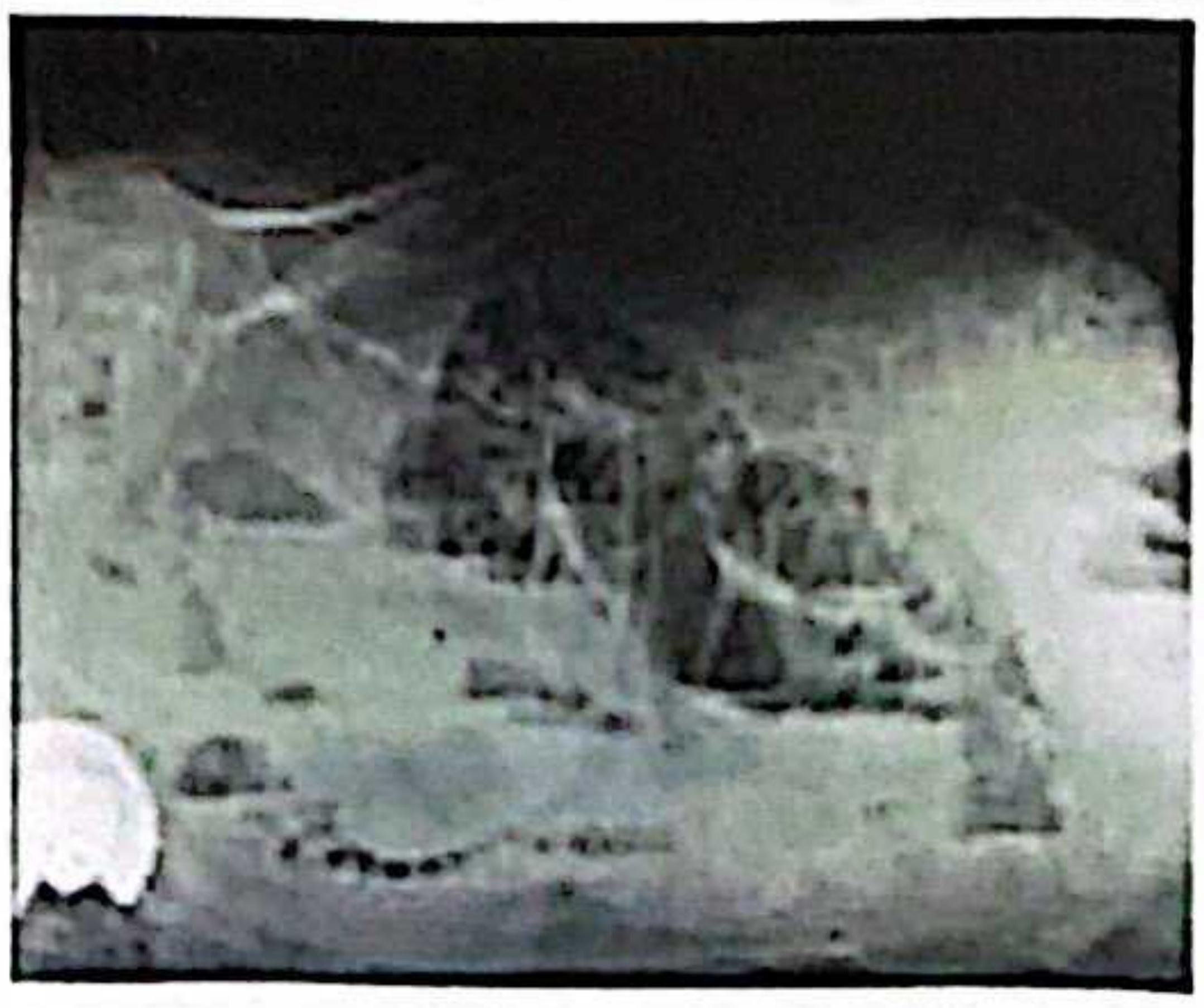
1. The patient is erect against the upright detector with the knee and ankle joint in contact with the detector
2. Leg is extended
3. Ensure the knee is not rotated

Centring: Centre of the knee 1.5 cm distal to the apex of the patella

Indications: This view is often used to asses osteoarthritis

Q.8) Identify? (2014)





Identify the view: Abdominal radiograph with Left lateral decubitus view

Positioning:

1. The patient is lying on either the left (left lateral decubitus) or right (right lateral decubitus) side
2. The left lateral decubitus is preferred as any free intraperitoneal gas will be contrasted by the liver
3. The detector can be placed anteriorly or posteriorly
4. Patient's hands should be raised to avoid superimposing on the region of interest; legs may be flexed for balance
5. Rotation of shoulders or pelvis should be minimised, but not as critical as on other abdominal radiographic views
6. Patients should be changed into a hospital gown, with radiopaque items (e.g. Belts, zippers) removed
7. X-ray is taken in full inspiration

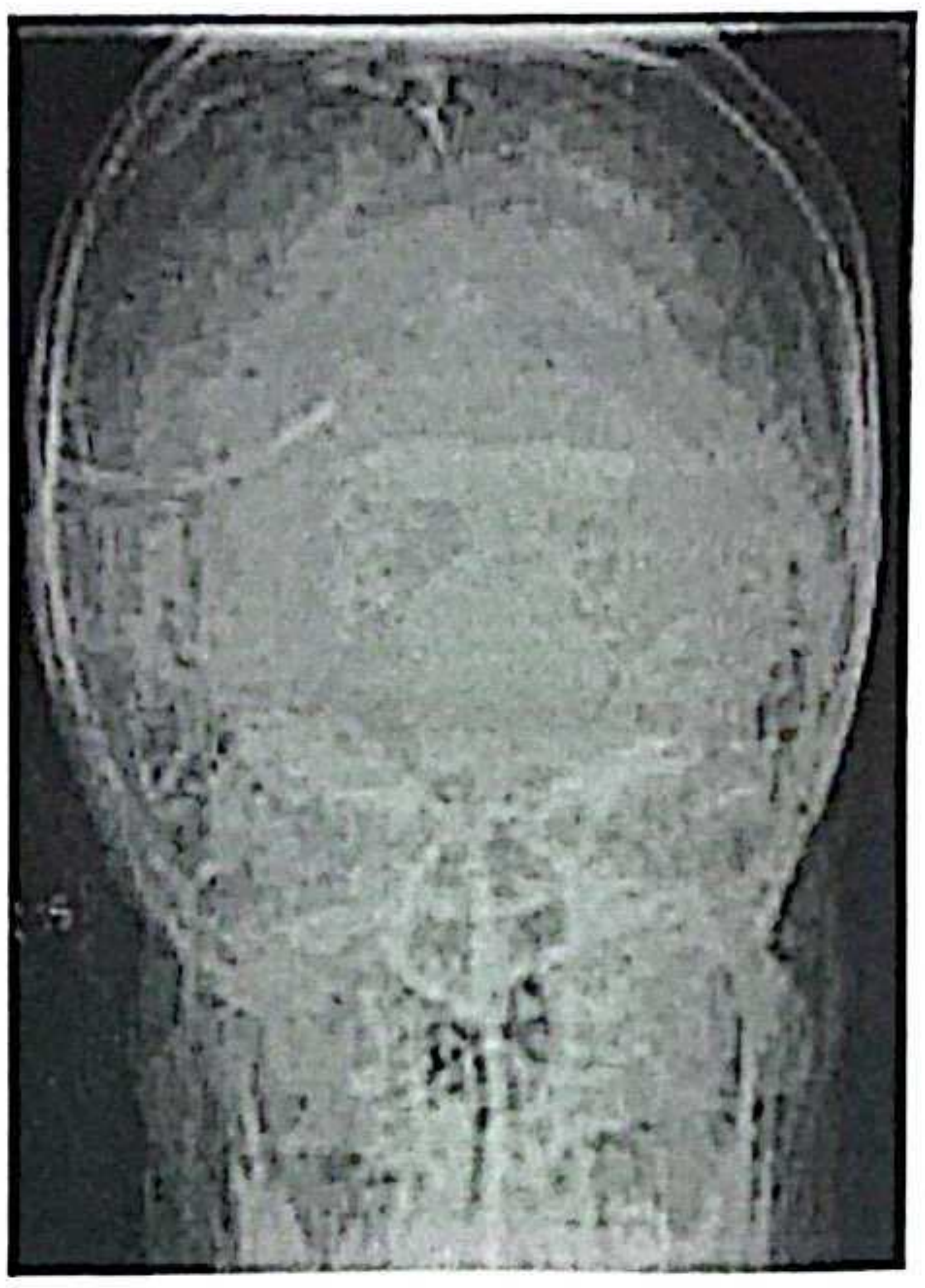
Centring: Midsagittal place (xiphisternum) just superior to the iliac crest

Indications:

1. Used to identify free intraperitoneal gas (pneumoperitoneum).
2. It can be performed when the patient is unable to be transferred to, or other imaging modalities (e.g. CT) are not available.

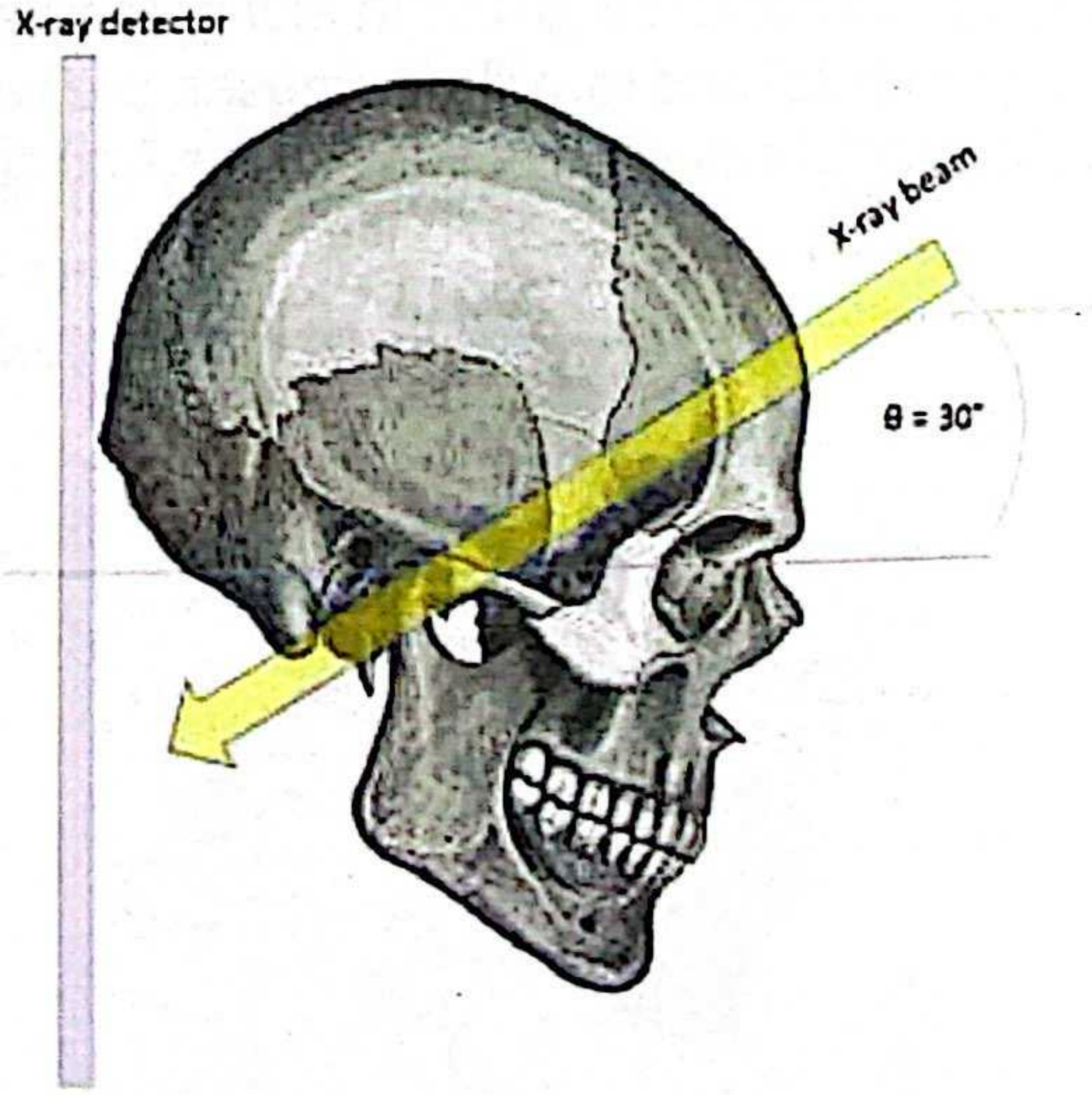
Dilated loops of bowel with air-fluid levels at different levels is compatible with a small bowel obstruction. "String of pearls" sign is present in the lower abdomen.

Q.9) Identify?

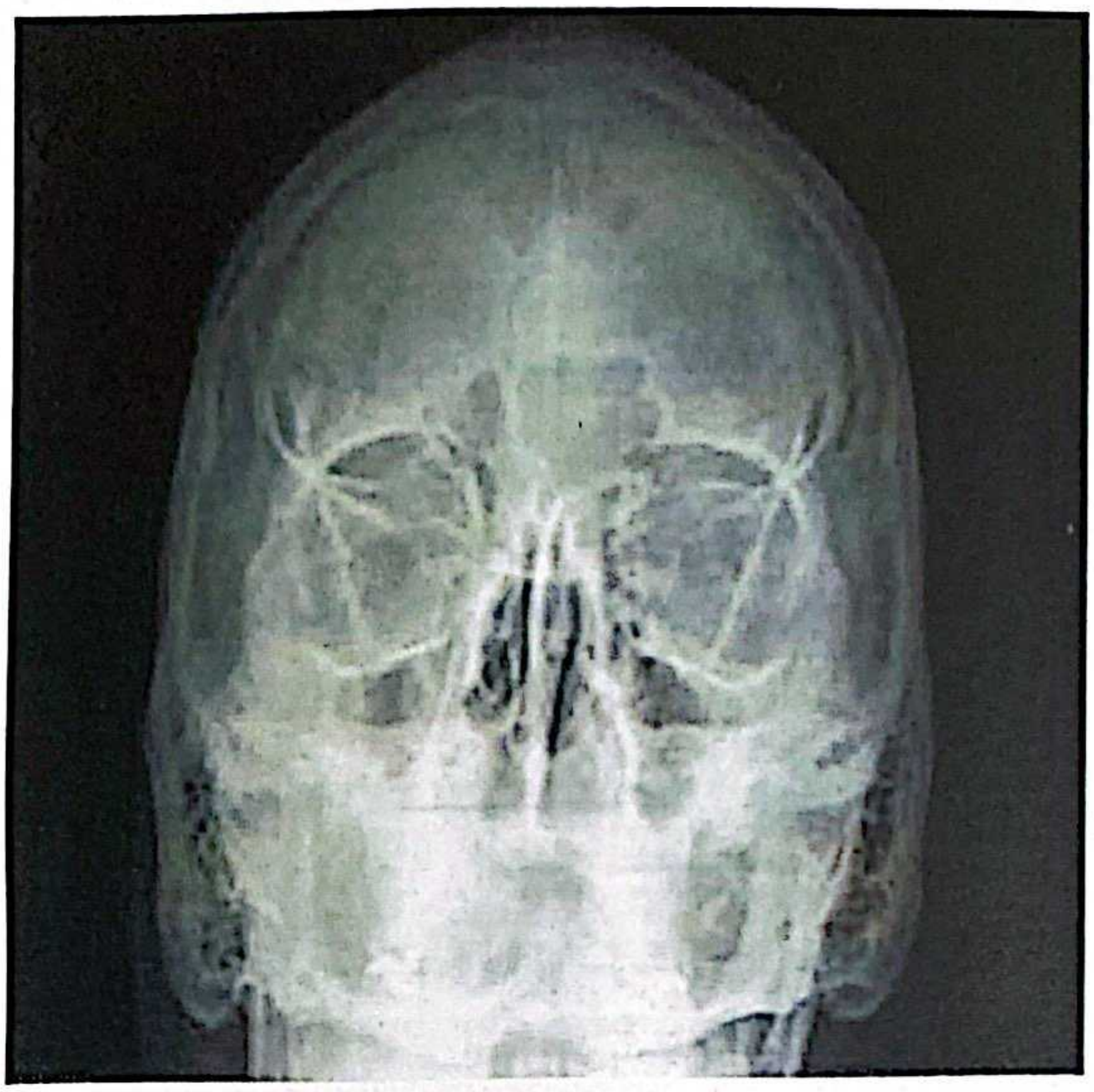


Identify the view: Skull Towne view AP radiograph of the skull
Positioning: Supine/erect, both mid sagittal plane & orbitomeatal line perpendicular to film
Centring: 30^0 caudal angulations to enter 2 inches (or 6cm) above glabella (hairline level) and exit and foramen magnum
How to identify: Foramen magnum & odontoid seen
Indications:

1. Posterior clinoid process
2. Foramen magnum
3. Internal accoustic canal
4. Fractures of the skull
5. Neoplastic changes



Q.10) Identify?



Identify the view: Caldwell view PA radiograph of the skull

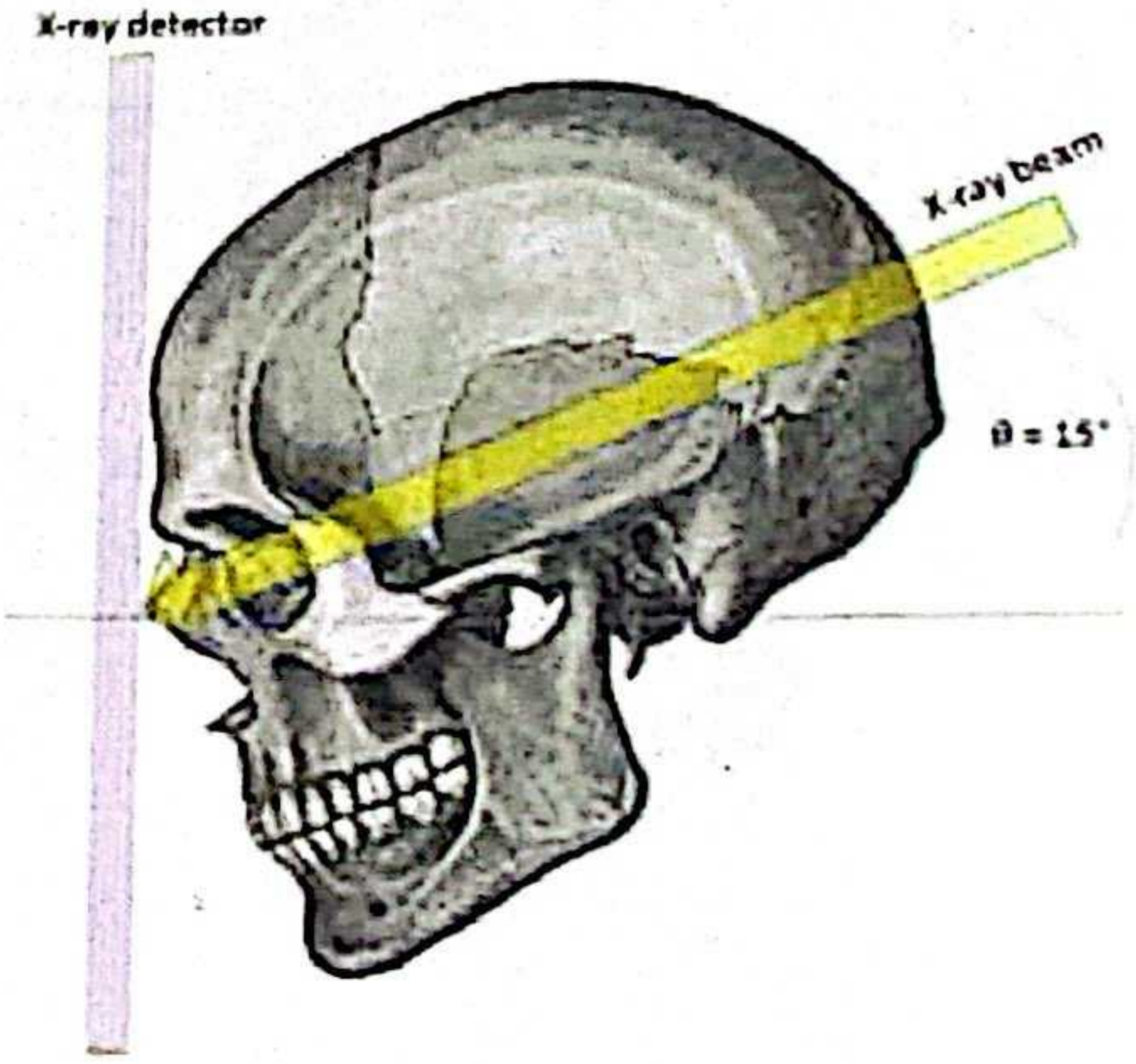
Positioning:

1. The patient is seated in front of the upright detector
2. The patient's forehead is placed against the image detector
3. Forehead and nose are both touching the detector
4. The orbitomeatal line is running perpendicular to the detector
5. Petrous ridge is below orbits

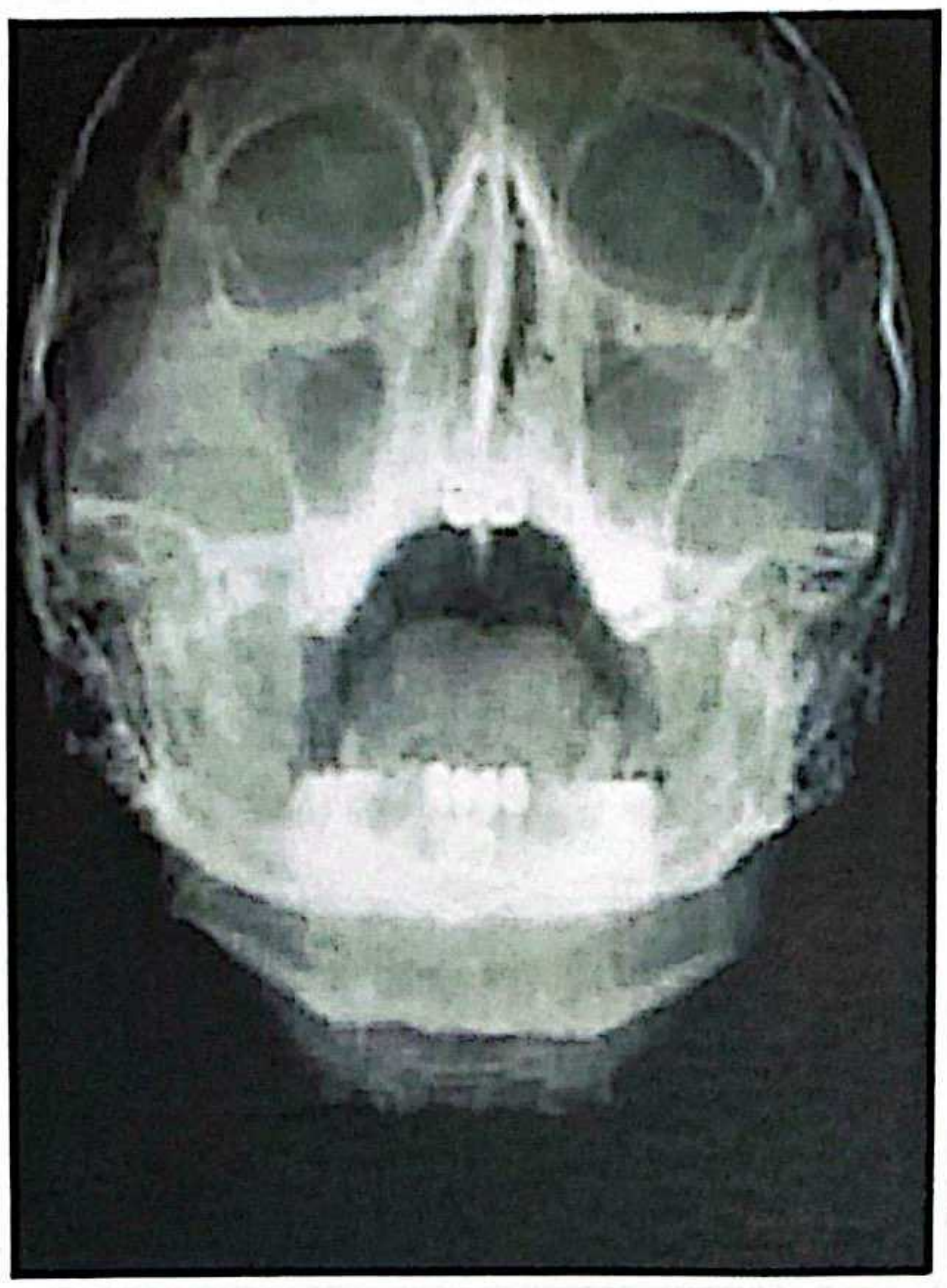
Centring: Angled caudad around 15° to exit at the nasion

How to identify: Frontal and maxillary sinuses are well seen

Indications: Paranasal sinuses, especially the frontal sinus



Q.11) Identify?



Identify the view: Occipitomental (OM), Parietocanthial or Waters view PA radiograph of the skull

Positioning:

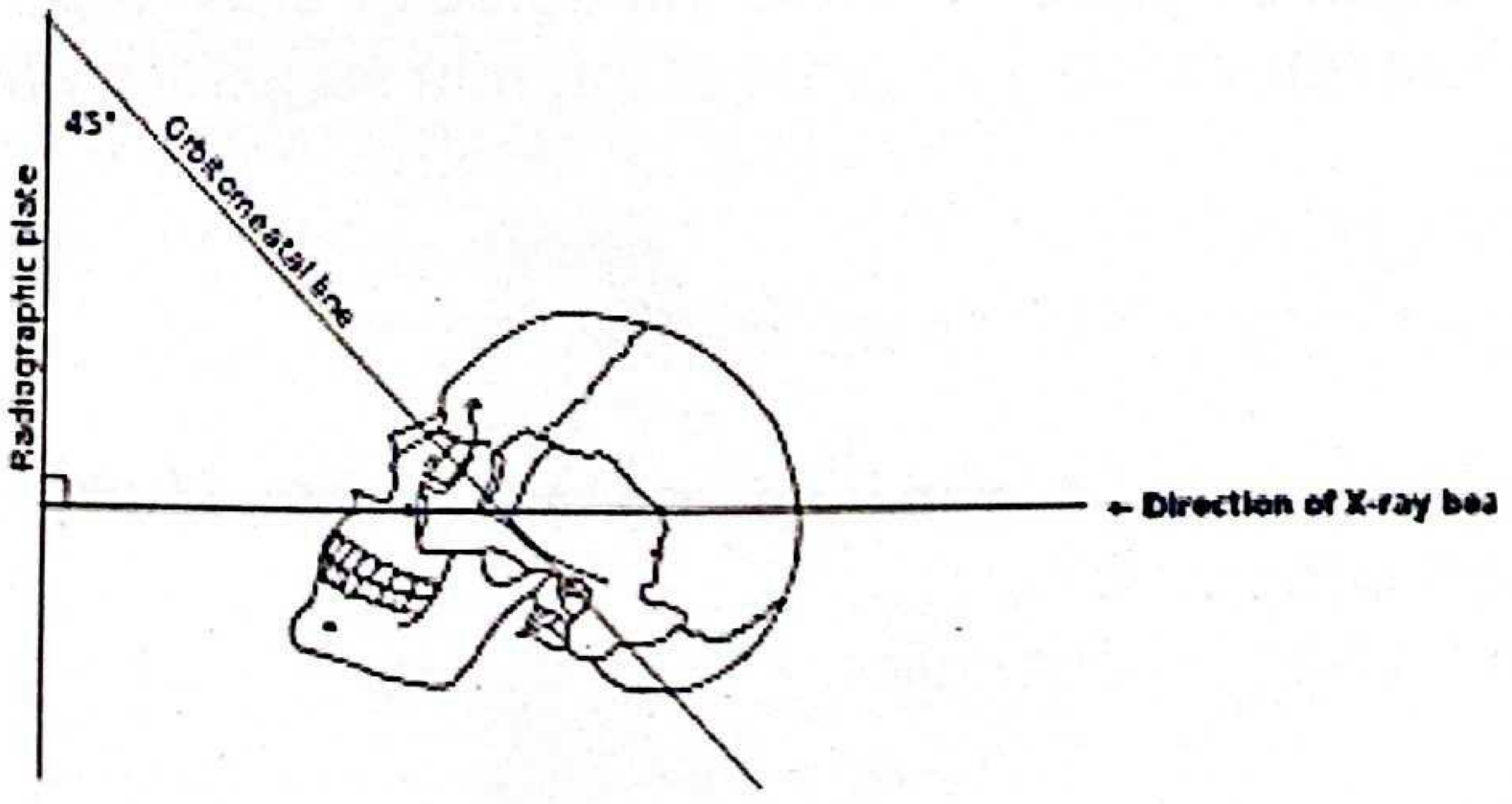
1. The patient is erect facing the upright detector
2. The chin is raised until the mento-mandibular line is perpendicular to the receptor
3. Orbitomeatal line will be 45 degrees from receptor
4. Ensure patients head is straight

Centring: Perpendicular to film to exit at acanthion

How to identify: Prominent maxillary sinus & mandible angled upwards

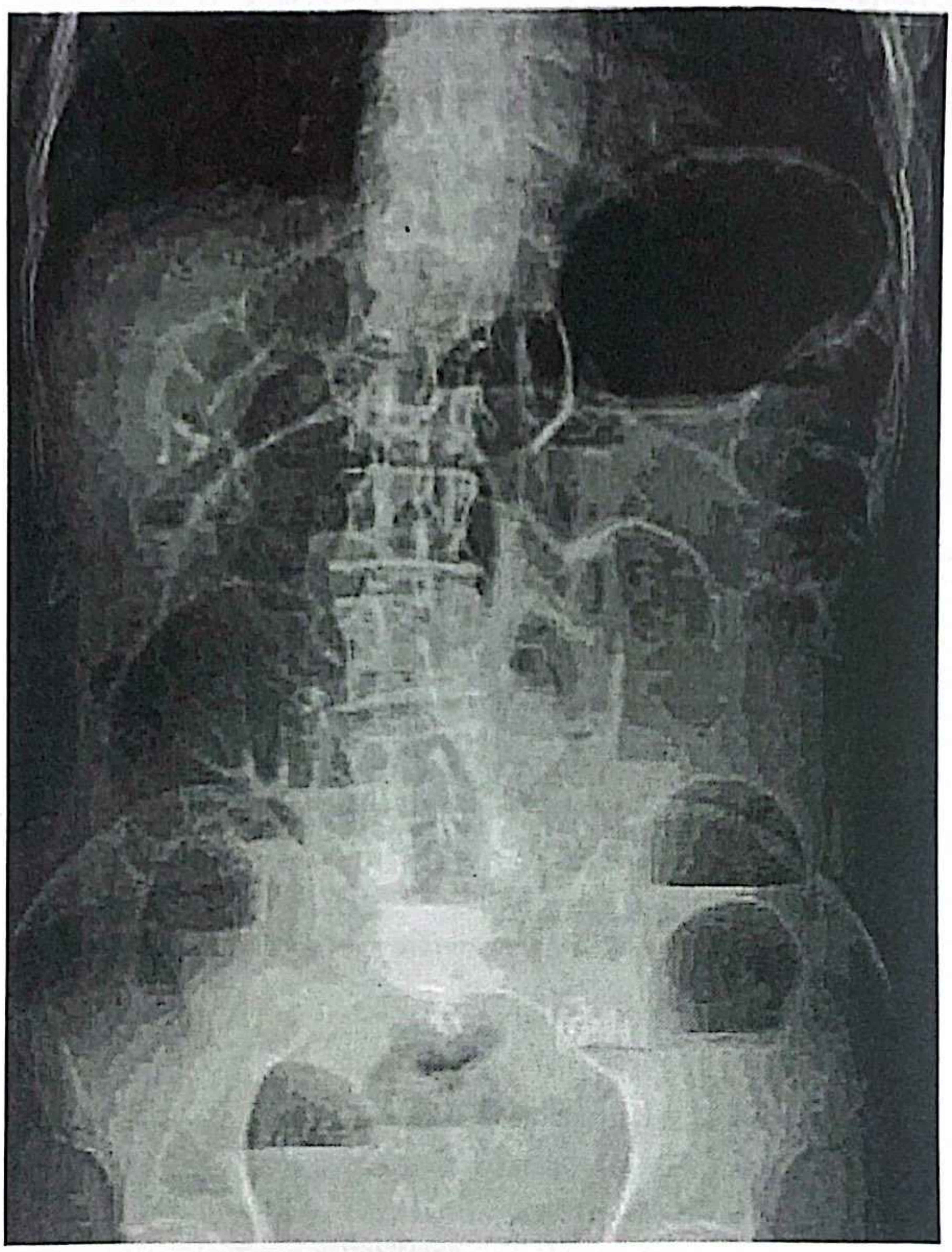
Indications:

1. Assess for facial fractures
2. Acute sinusitis
3. Maxillary sinus issues



Water's radiographic view of skull

Q.12) Identify?



Identify the view: Plain Radiograph Abdomen PA erect view
Positioning:

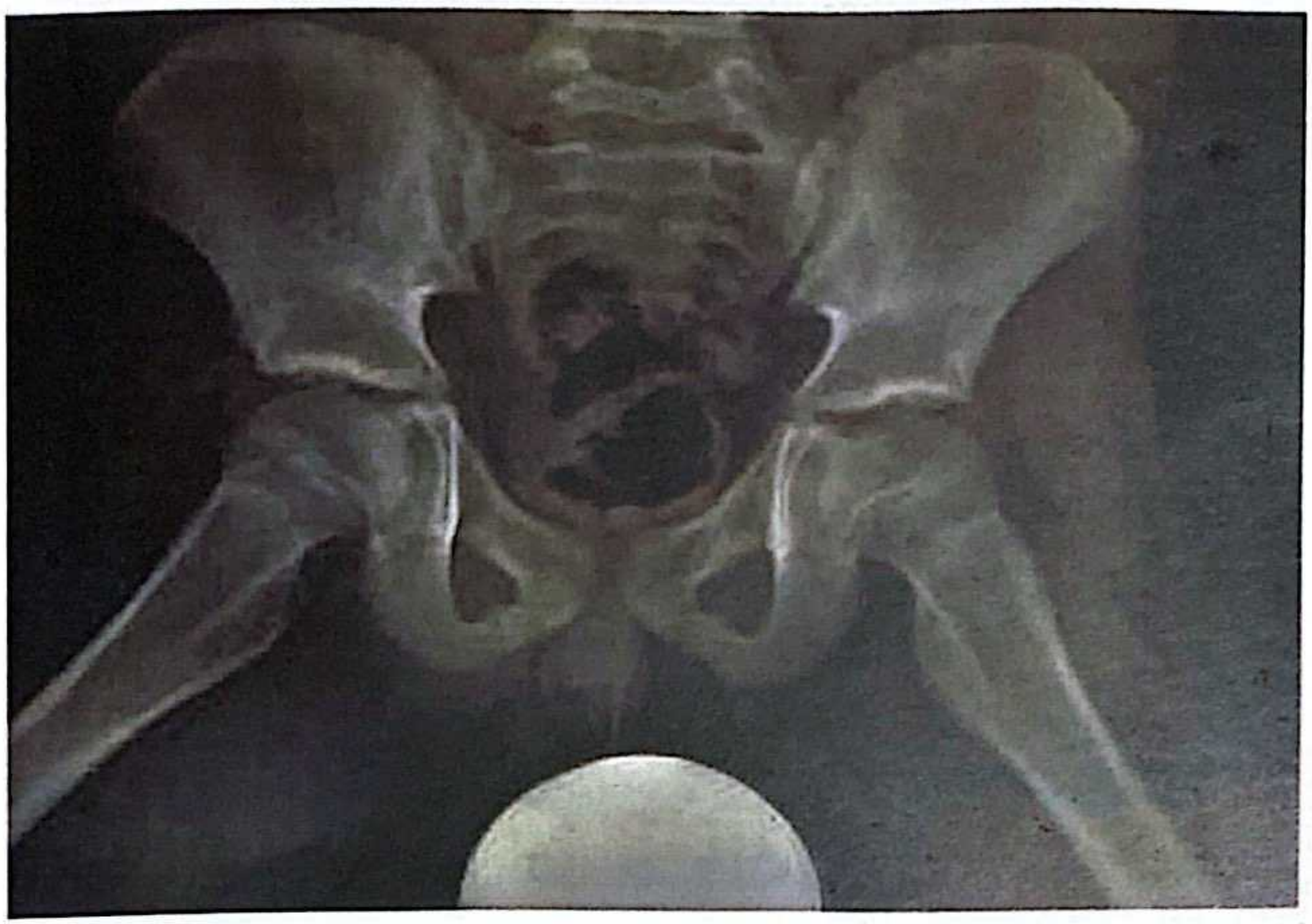
1. The patient is standing, with ventral abdomen toward the image detector
2. No rotation of shoulders or pelvis
3. Should include the entire transverse width of the patient (if possible; if not, two radiographs may be obtained)
4. Hands can be placed around the detector or on top

Centring: 5cm above the iliac crest at the mid saggital plane
Indications:

1. Air fluid levels
2. Free air in the abdominal cavity

Describe: Dilated small bowel loops on supine film. Multiple air/fluid levels on erect film
Diagnosis: Intestinal obstruction

Q.13) Identify?



Identify the view: Plain Radiograph both hip joints frog leg lateral view or modified Cleaves method

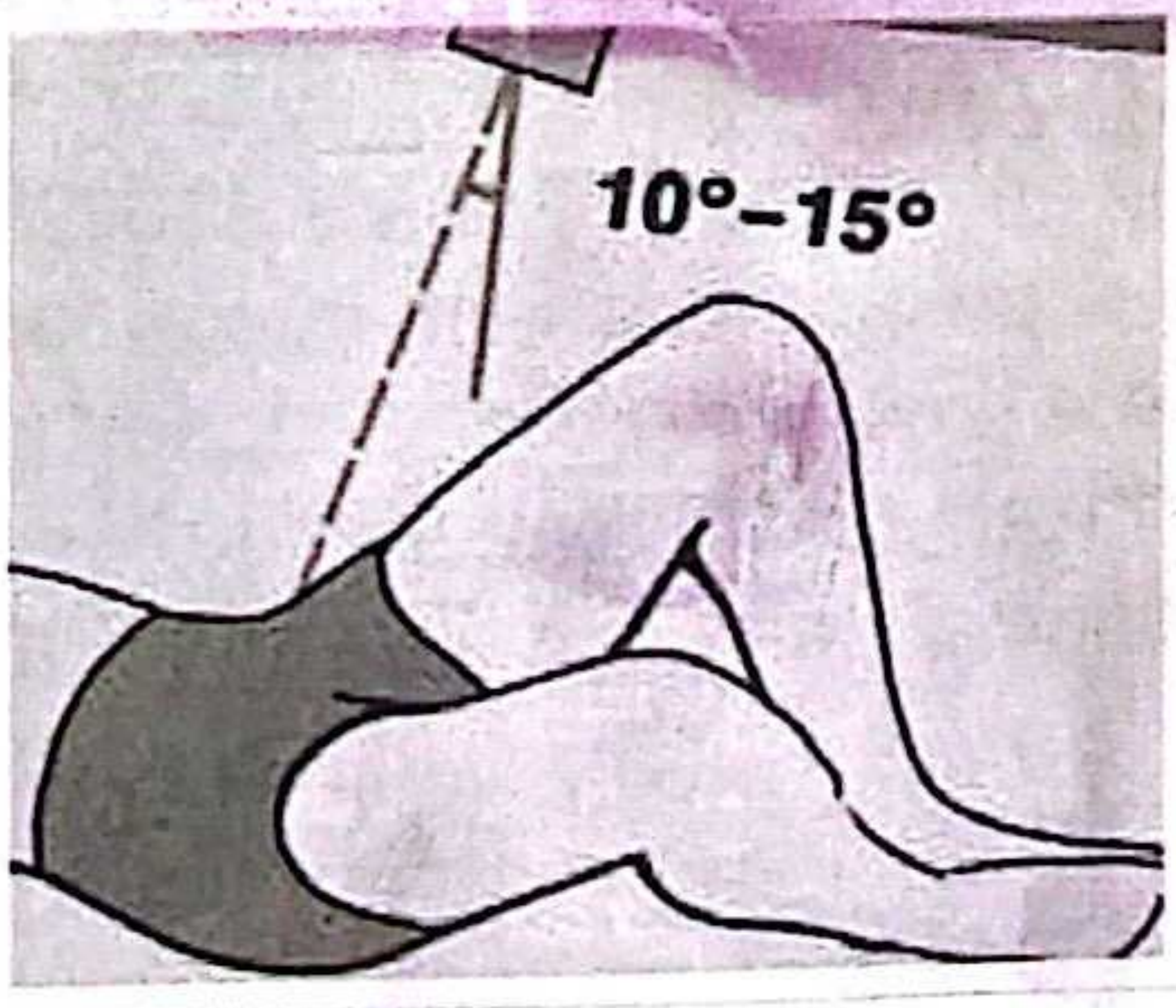
Positioning:

1. The patient is supine
2. The affected limb flexed at the knee approximately 30° to 40°
3. Hip abducted 45° (this can be bilateral)
4. If unilateral the heel of the affected limb should rest against the medial aspect of the contralateral knee
5. If it is a bilateral examination, both knees are to be resting on sponges, giving the appearances of "frog legs"

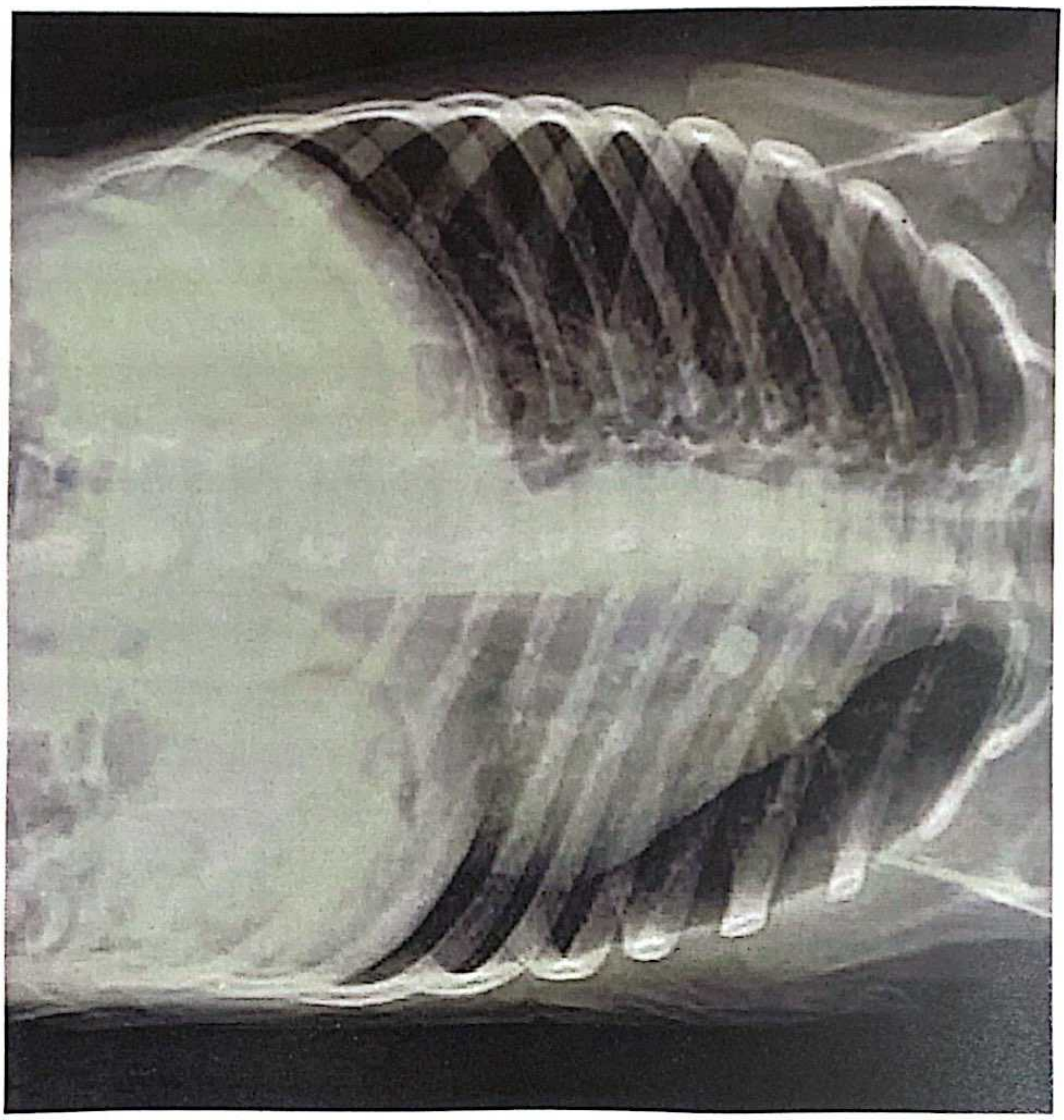
Centring: Midway between the anterior superior iliac spine and the pubic symphysis

Indications:

1. Slipped capital femoral epiphysis
2. Perthes disease
3. Non-traumatic hip
4. DDH (congenital hip dislocation)



Q.14) Identify?



Identify the view: Plain Radiograph Chest Lateral decubitus view

Positioning:

1. The patient is laying either left lateral or right lateral on a trolley on top of a radiolucent sponge

Note: when investigating pneumothorax the side of interest should be up; when investigating pleural effusions the side of interest should be down

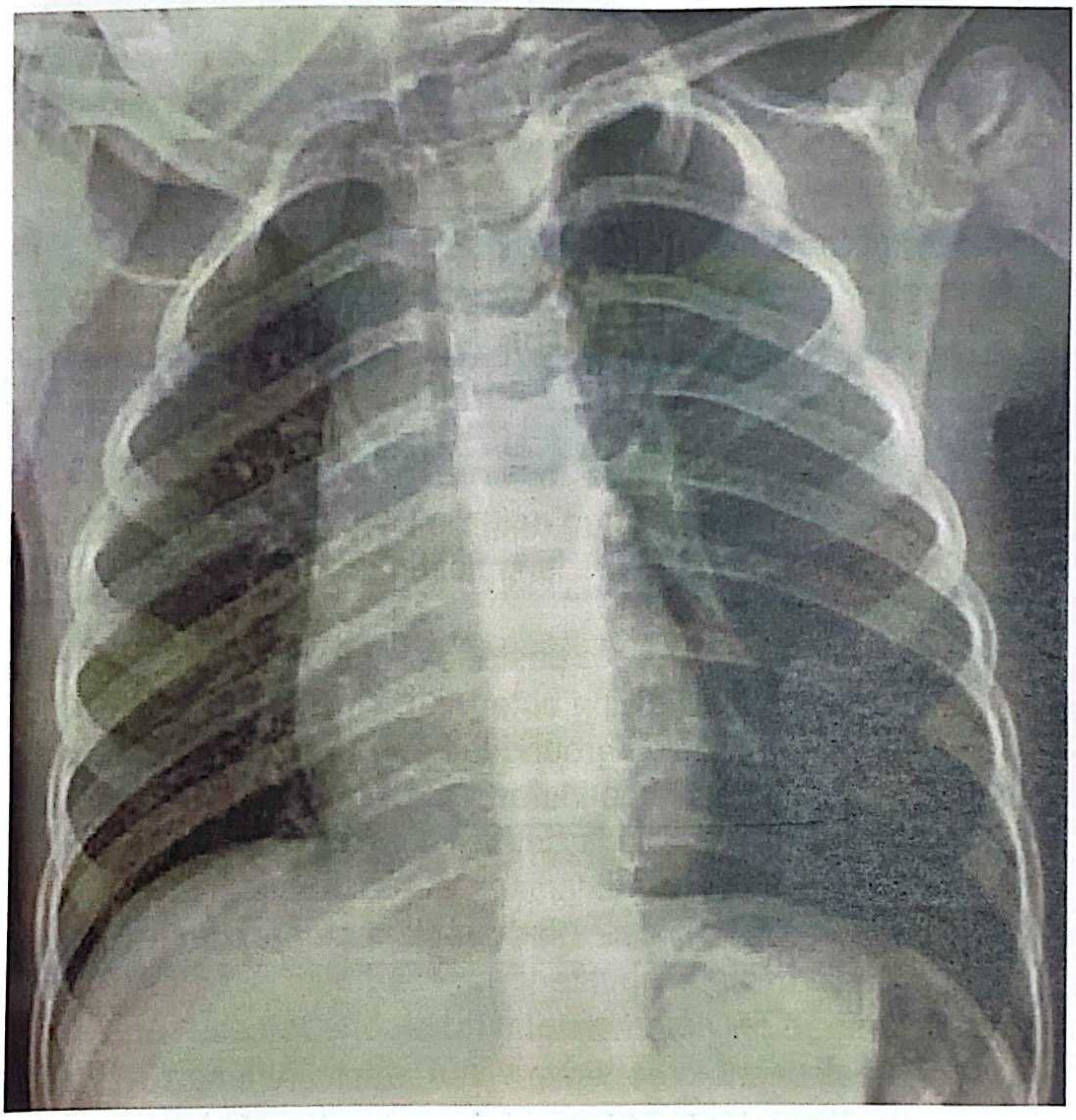
2. The detector is placed landscape posterior to the patient running parallel with the long axis of the thorax
3. Patient's hands should be raised to avoid superimposing on the region of interest, legs may be flexed for balance
4. Rotation of shoulders or pelvis should be minimised
5. Patients should be changed into a hospital gown, with radiopaque items (e.g. Belts, zippers) removed
6. X-ray is taken in full inspiration

Centring: Midsagittal place (xiphisternum) at the level of T7

Indications:

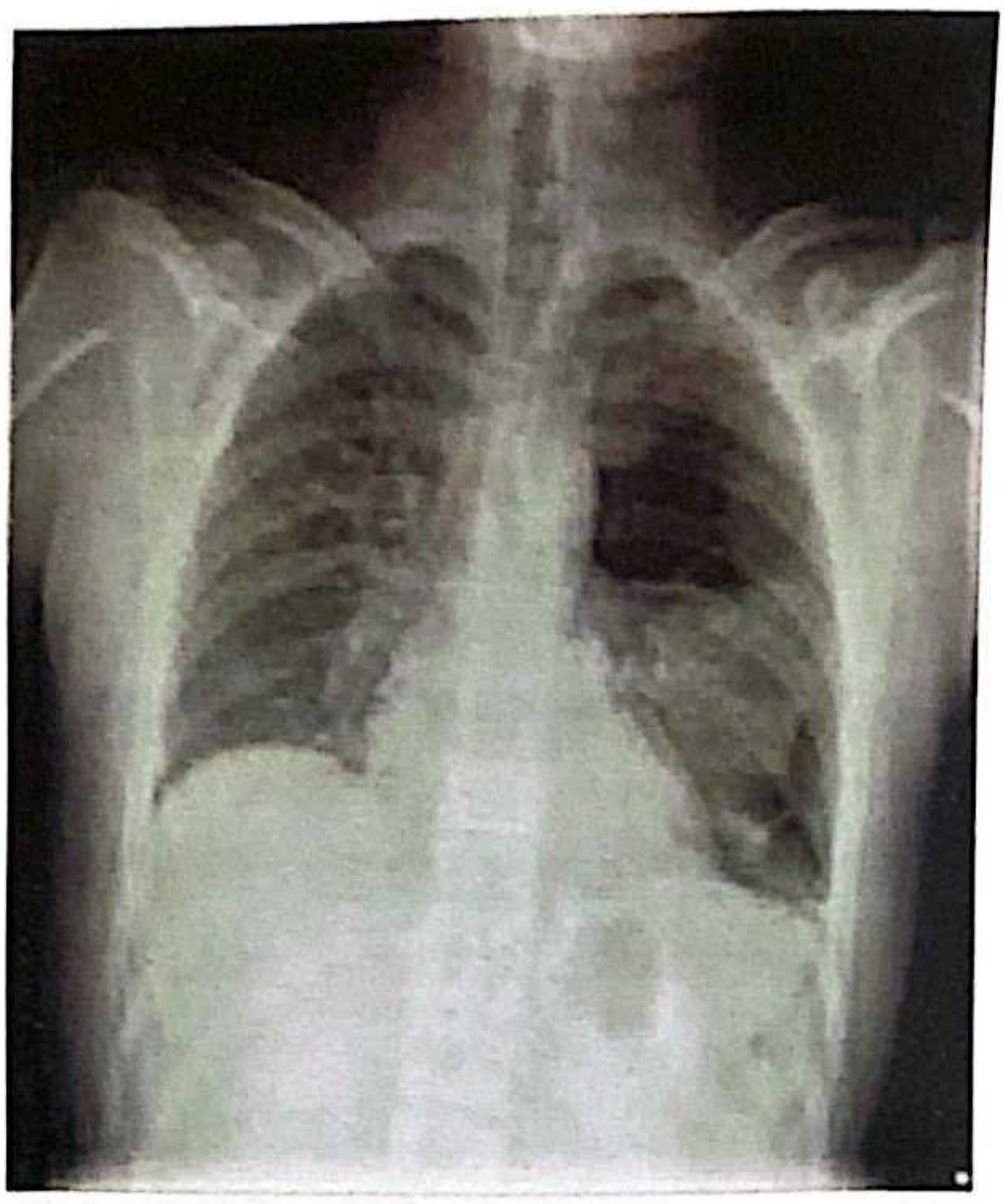
1. Small pleural effusions
2. Pneumothorax
3. Air trapping due to inhaled foreign bodies.

Diagnosis: A radiopaque foreign body is demonstrated projected over the left hilum. There is consequent air-trapping confirming the obstruction.



Both lungs are well expanded and there is no focal collapse or consolidation. There is slightly increased density over the left hilum. In this case, the lateral Decubitus highlighted the radiodense stone obstructing the left main bronchus which was barely visible on the frontal projection.

Q.15) Identify?



Identify the view: Expiratory chest Plain radiograph PA view

Positioning:

1. Patient is erect facing the upright image receptor, the superior aspect of the receptor is 5 cm above the shoulder joints
2. The chin is raised as to be out of the image field
3. Shoulders are rotated anteriorly to allow the scapulae to move laterally off the lung fields, this can be achieved by either:
4. Hands placed on the posterior aspect of the hips, elbows partially flexed rolling anterior or
5. Hands are placed around the image receptor in a hugging motion with focus on lateral movement of the scapulae
6. Shoulders are depressed to move the clavicles below the lung apices

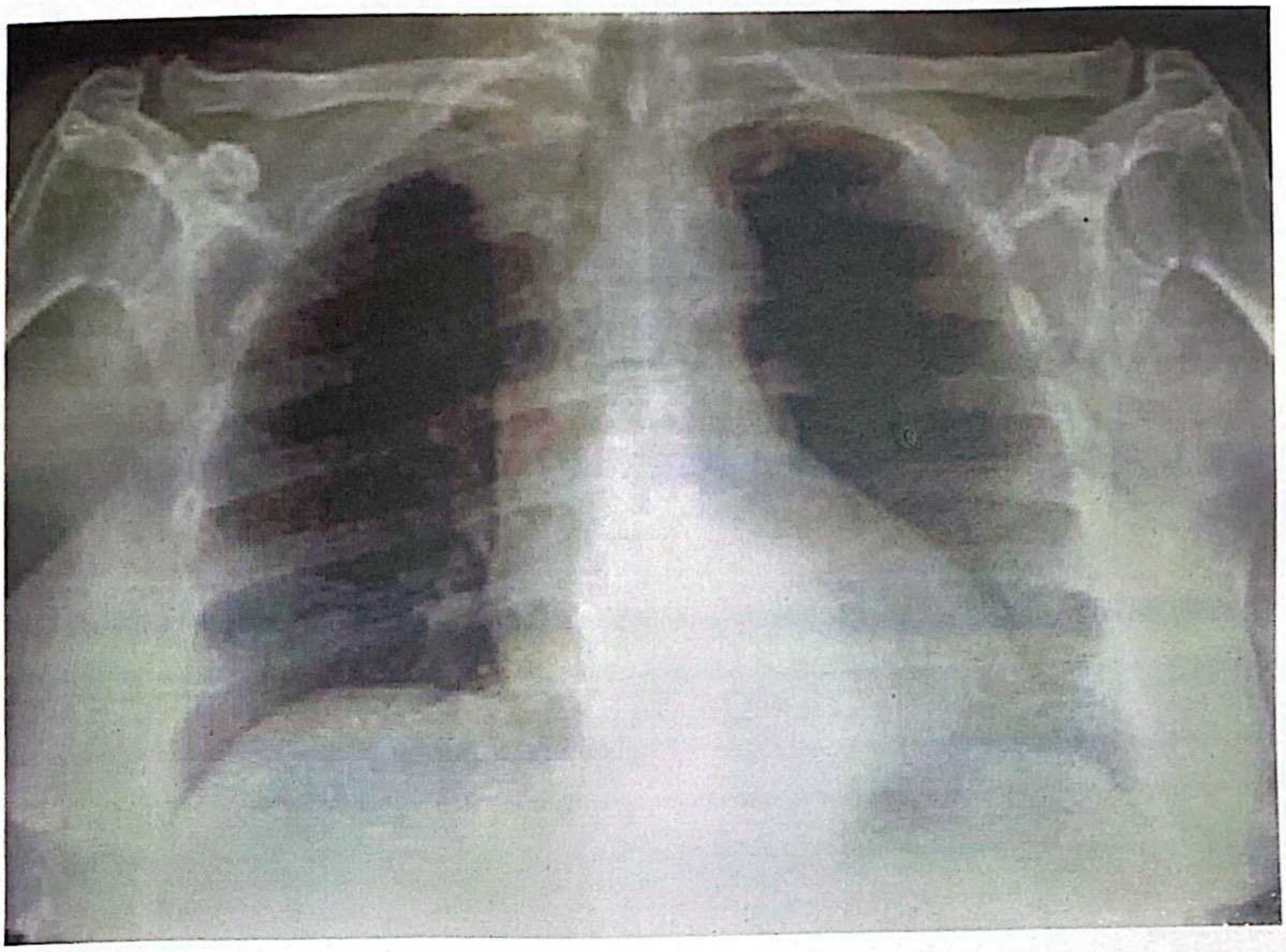
Centring: The level of the 7th thoracic vertebra, approximately the inferior angle of the scapulae

Indications:

1. Small pneumothoraces
2. Inhaled foreign bodies
3. Gas trapping in COPD

Diagnosis: Large left pneumothorax, much more obvious on the expiratory projection. Mediastinal shift to suggest tension. No displaced rib fracture identified.

Q.16) Identify?



Identify the view: Plain AP Chest radiograph Lordotic View or Axial View

Positioning:

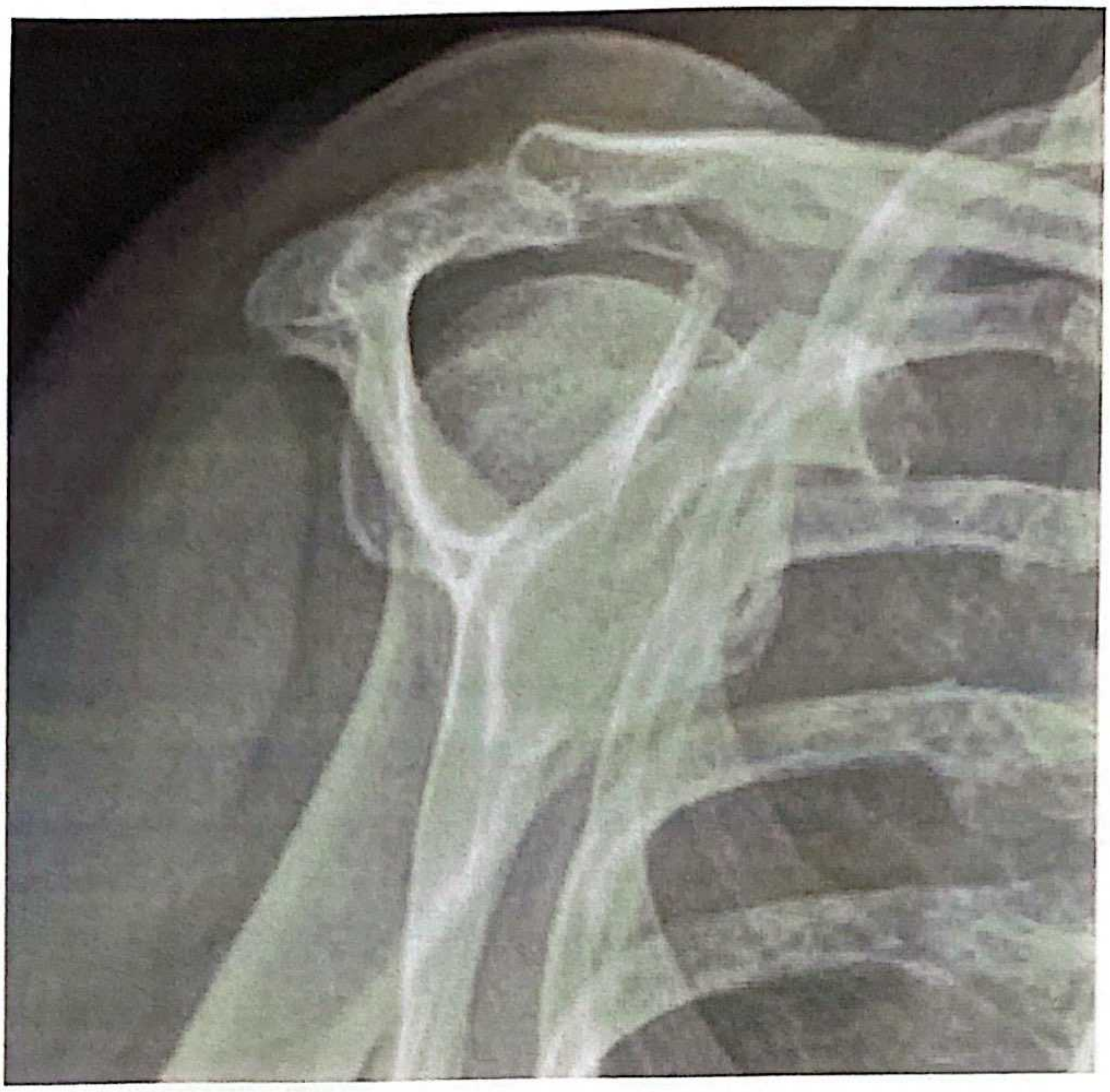
1. The patient is standing with feet approximately 30cm away from the image receptor, with back arched until upper back, shoulders and head are against the image receptor
2. The shoulders and elbows are rolled anteriorly
3. The angle formed between the midcoronal body plane and image receptor should be approximately 45 degrees

Centring: Midsagittal plane, halfway between the manubrium and the xiphoid process

Indications:

1. Areas of the lung apices that appear obscured on the PA/AP chest radiographic views.
2. Suspicious areas within the lung apices that appeared obscured by overlying soft tissue, upper ribs or the clavicles on previous chest views
3. Tuberculosis

Q.17) Identify?



Identify the view: Plain Radiograph Shoulder outlet view or neers projection

Positioning:

1. Erect or sitting, facing the upright detector
2. Rotated in an anterior oblique position, so the anterior portion of the shoulder is touching the upright detector
3. The hand is placed on the patient's abdomen with the arm flexed
4. The degree of anterior rotation can vary from patient to patient
5. Scapula should be end-on to the upright detector, and this can be done via palpation of the scapula border

Centring:

1. The level of the glenohumeral joint on the posterior aspect of the patient (5 cm below the top of the shoulder)
2. 10-15-degree caudal angulation of the x-ray tube
3. Central to the medial scapula border

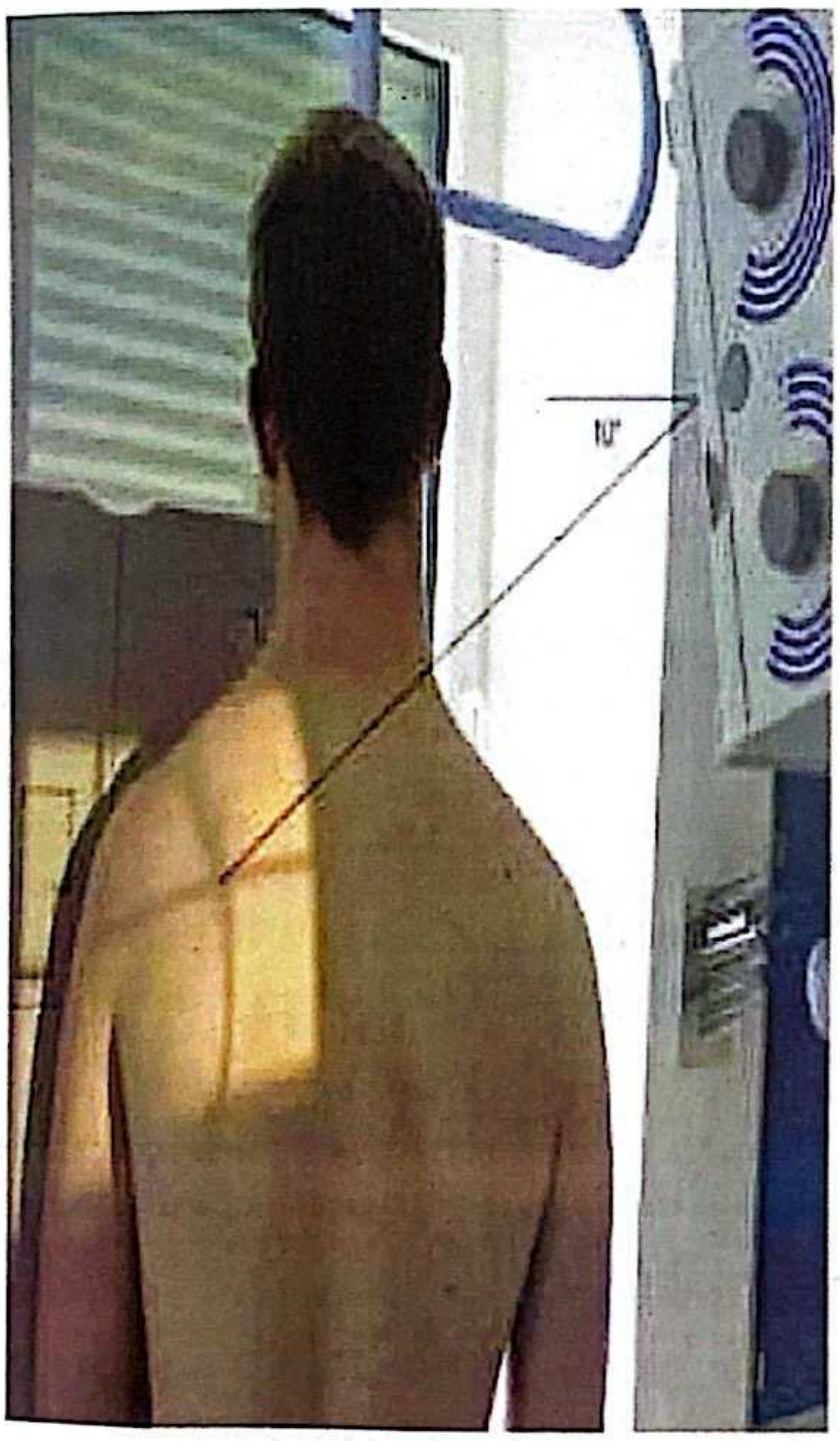
Indications:

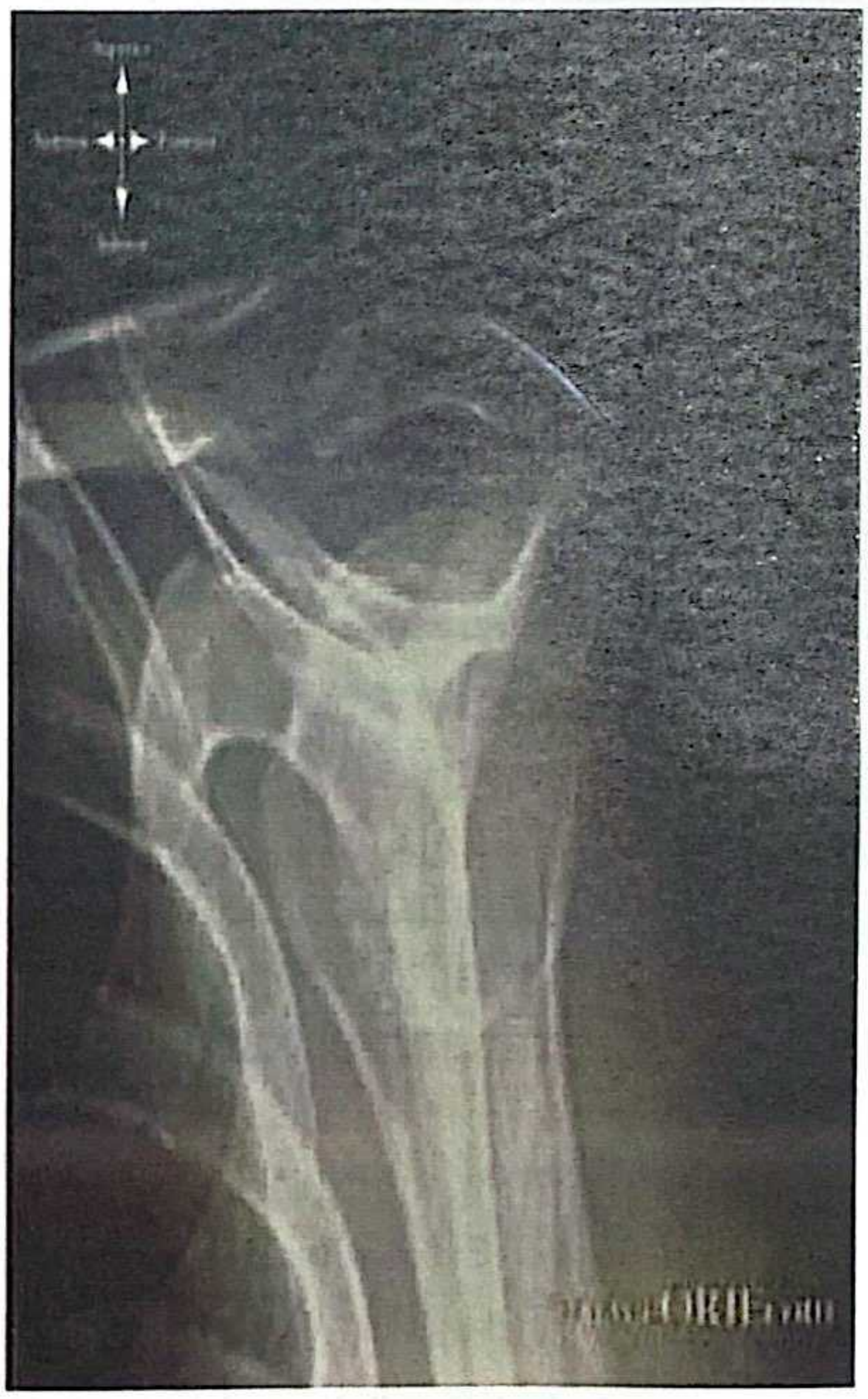
1. Demonstrating the coracoacromial arch
2. Speculated shoulder impingement

Contraindications:

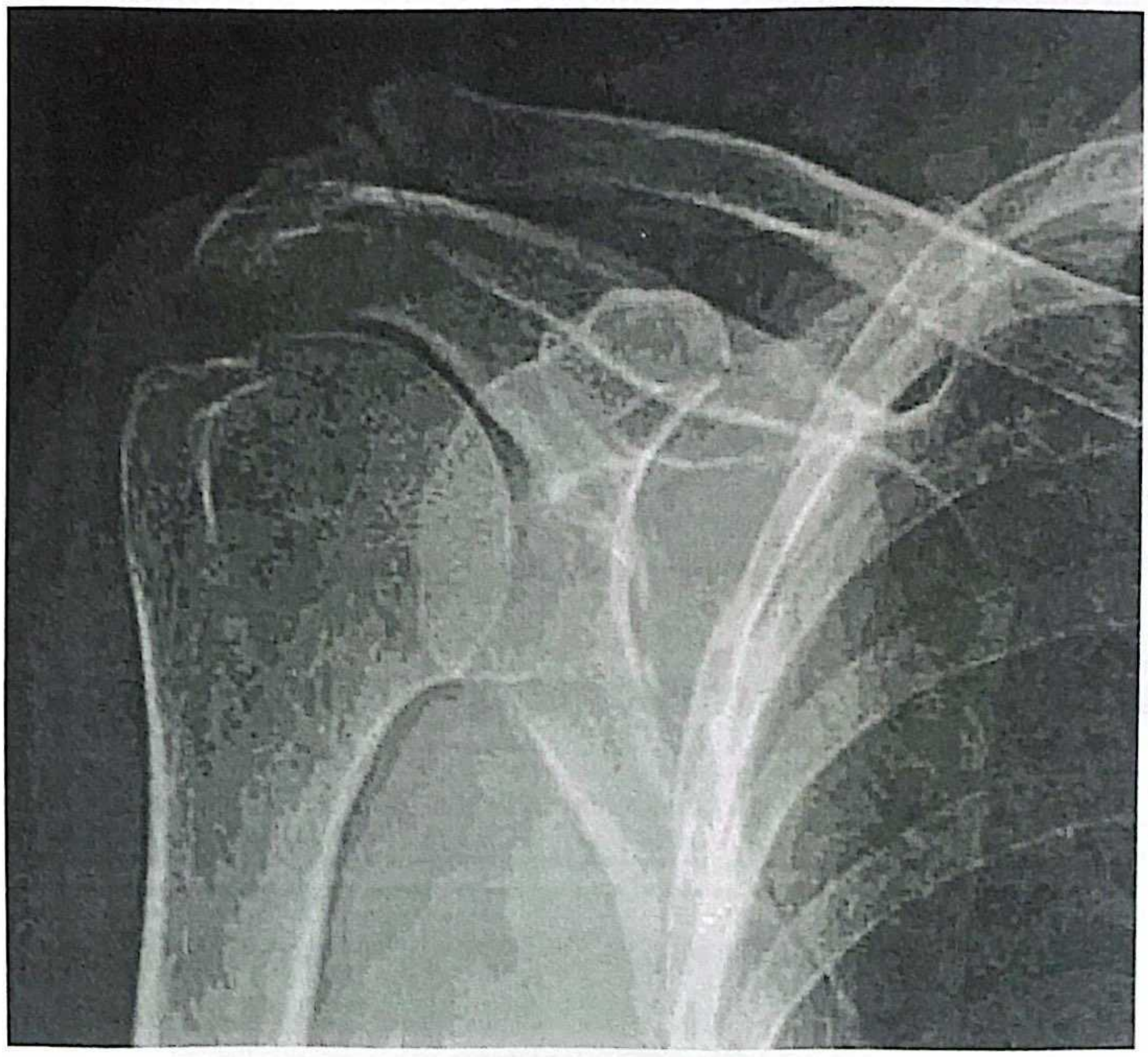
This projection is not advisable in acute imaging of the shoulder, angulation of the tub may result in elongation of decisive structures

Diagnosis: The acromioclavicular joint and glenohumeral joints are well aligned; there are moderate osteoarthritic changes involving the glenohumeral joint and the acromioclavicular joint. There is a loss of the subacromial space, suggesting subacromial impingement.





Q.18) Identify?



Identify the view: Plain AP Radiograph of Shoulder external rotation view

Positioning:

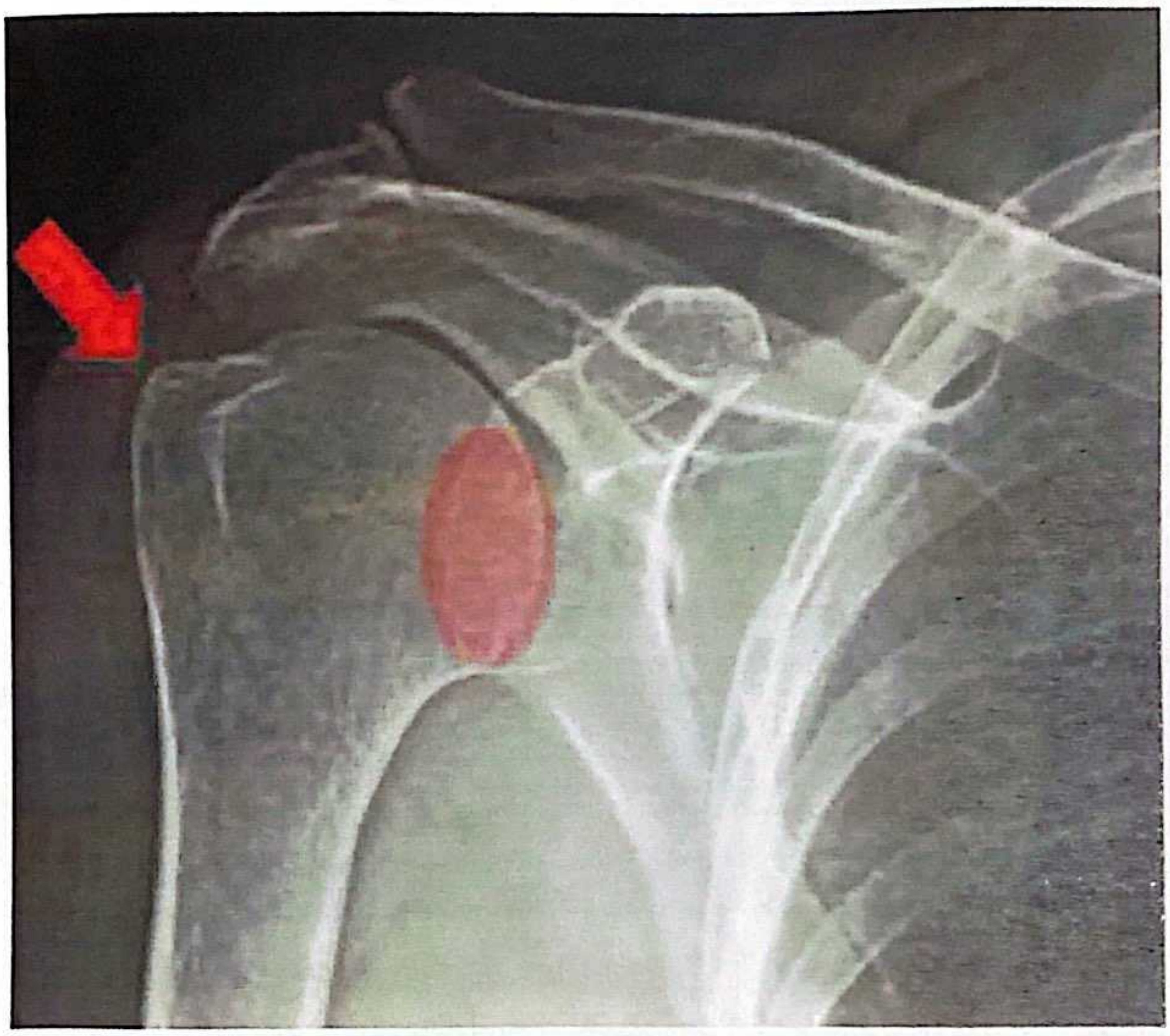
1. Patient is preferably erect
2. The midcoronal plane of the patient is parallel to the image receptor, in other words, the patient's back is against the image receptor
3. Glenohumeral joint of the affected side is at the centre of the image receptor
4. Affected arm is externally rotated
5. The patient is slightly rotated 5-10°. Therefore, the body of the scapula is laying parallel with the image receptor
6. Some departments may require further rotation to mimic that of 'true ap' projection

Centring: 2.5 cm inferior to the coracoid process, or 2 cm inferior to the lateral clavicle at the level of the glenohumeral joint

How to identify: Greater tuberiosity seen laterally, lesser tuberiosity seen superimposed

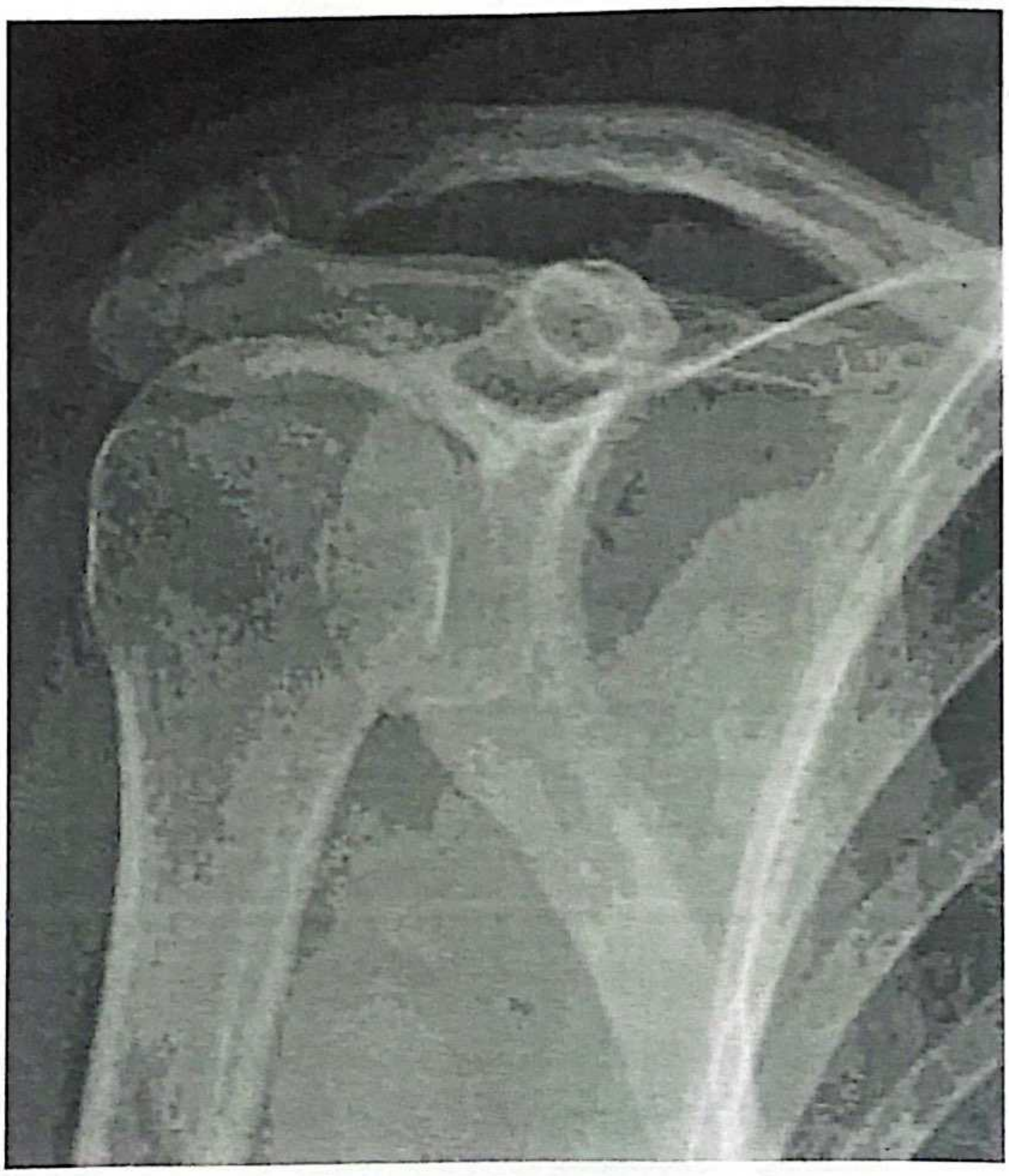
Indications:

1. Combined with the internal rotation view to visualise the entirety of the humeral head
2. Hill Sach's lesion



External rotation: The red arrow points to the greater tubercle of the humerus in profile. The red shaded oval is the overlap between the humeral head and the glenoid.

Q.19) Identify?



Identify the view: Plain AP Radiograph of Shoulder internal rotation view

Positioning:

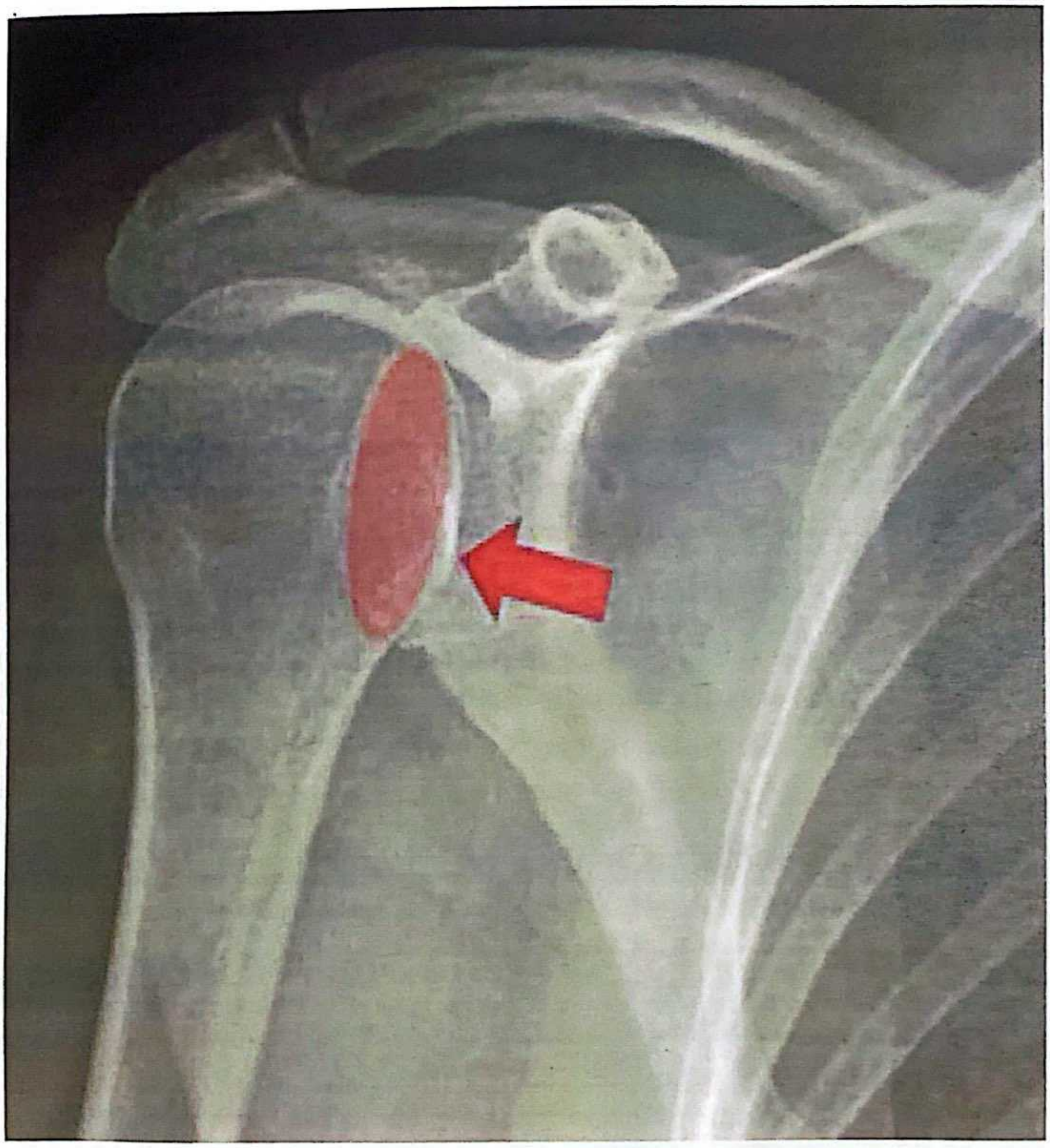
1. Patient is preferably erect
2. The midcoronal plane of the patient is parallel to the image receptor, in other words, the patient's back is against the image receptor
3. The glenohumeral joint of the affected side is at the centre of the image receptor
4. Affected arm is internally rotated
5. The patient is slightly rotated 5-10°. Therefore, the body of the scapula is laying parallel with the image receptor
6. Some departments may require further rotation to mimic that of 'true ap' projection

Centring:

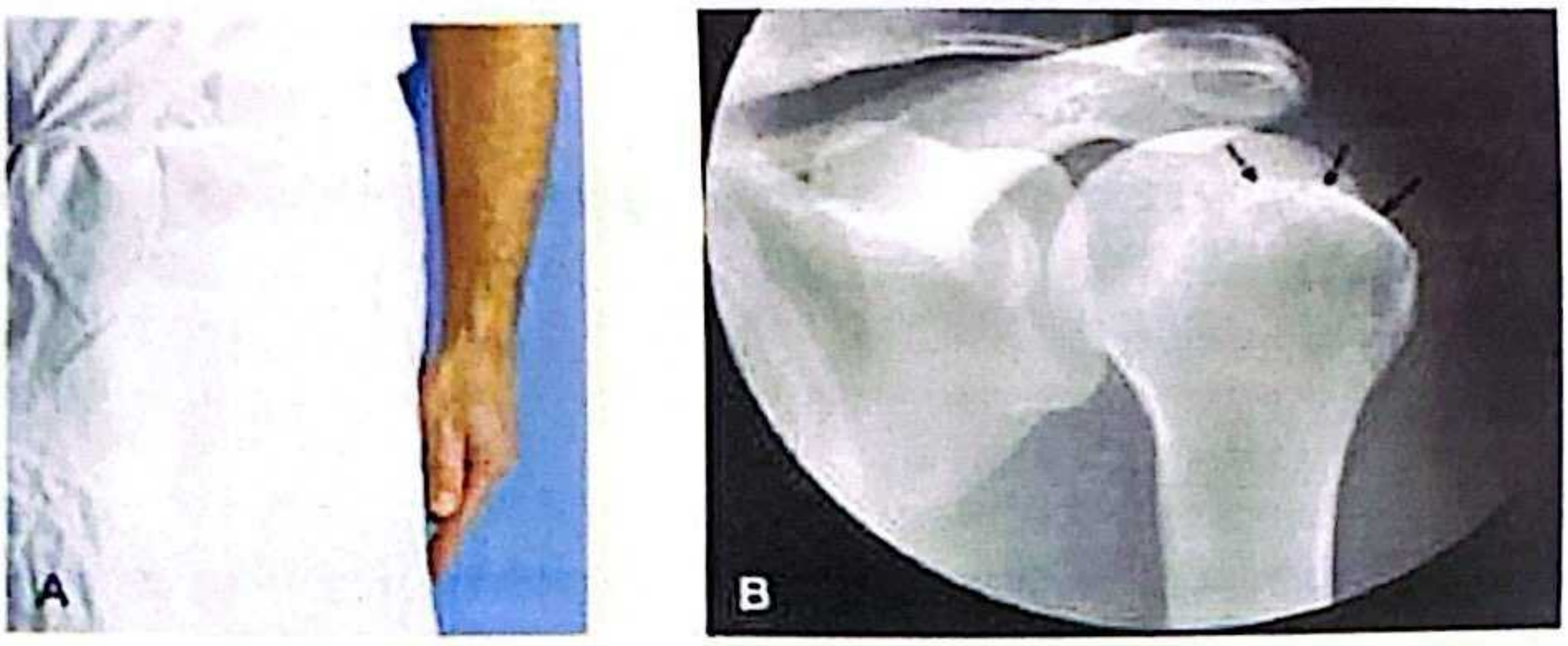
2.5 cm inferior to the coracoid process, or 2 cm inferior to the lateral clavicle at the level of the glenohumeral joint

Indications:

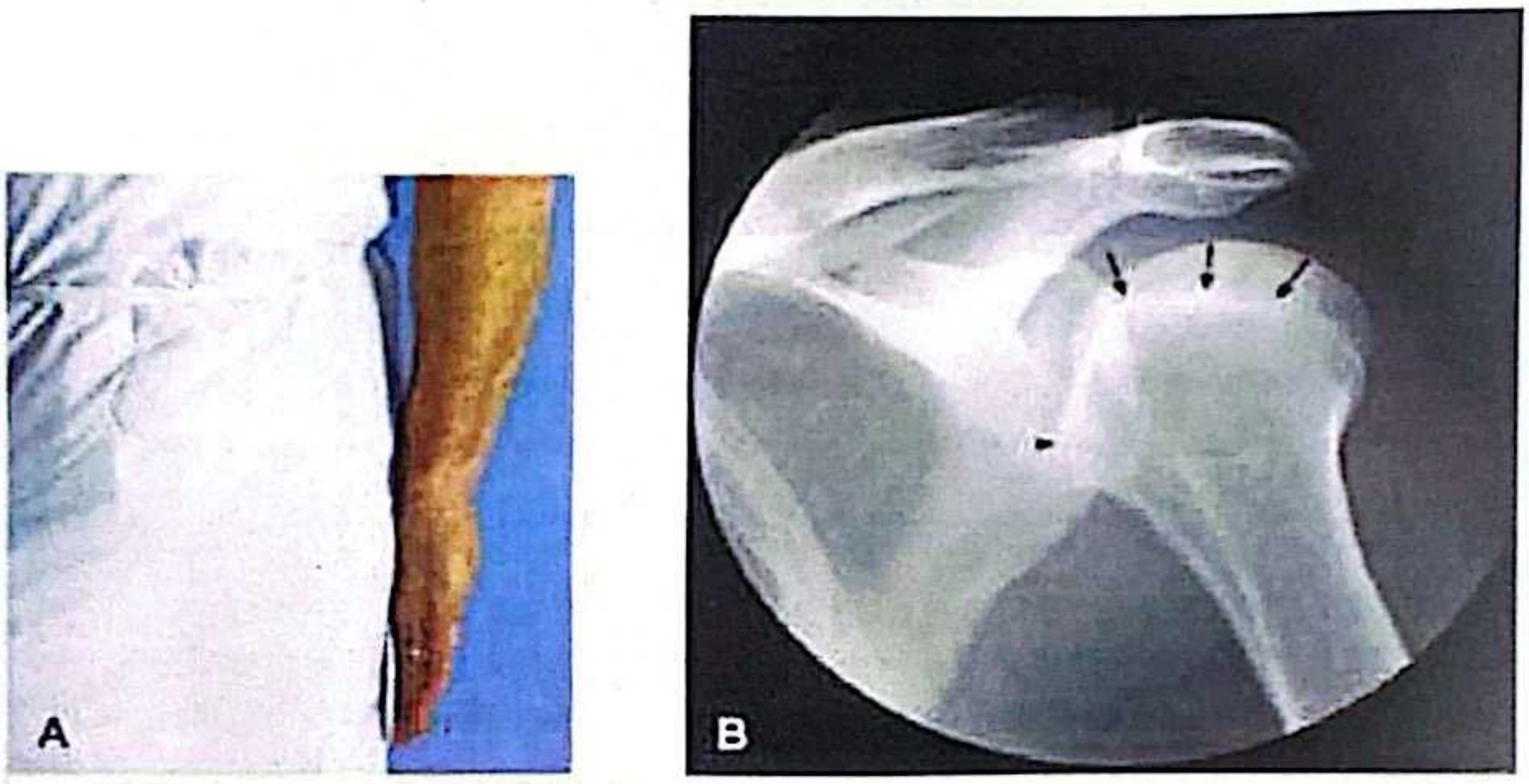
1. Combined with the external rotation view to visualise the entirety of the humeral head
2. Hill Sach's lesion



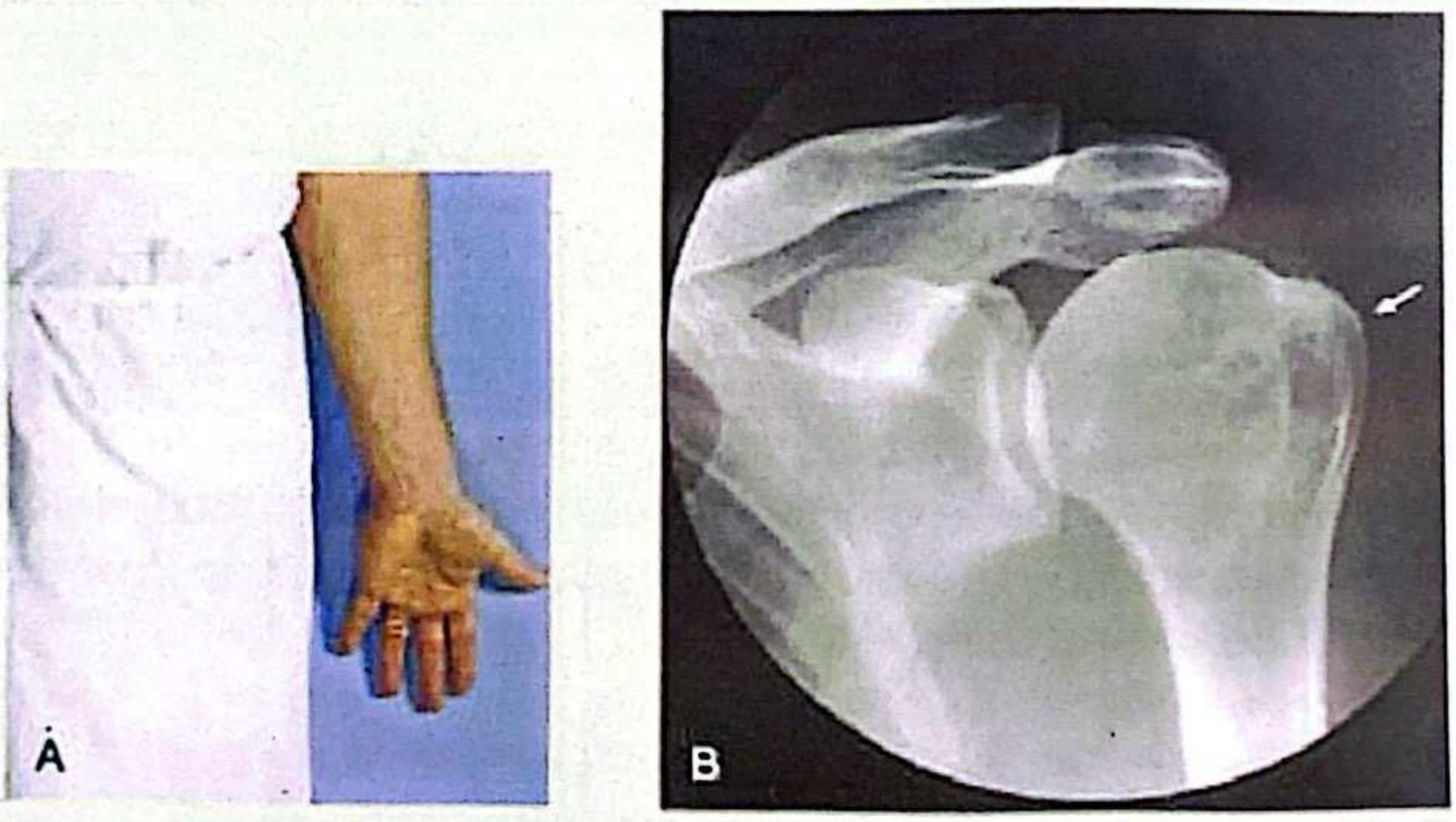
Internal rotation: The red arrow points to the lesser tubercle of the humerus in profile. The red shaded oval is the overlap between the humeral head and the glenoid.



AP shoulder. Neutral rotation humerus. Greater tubercle (*arrows*).

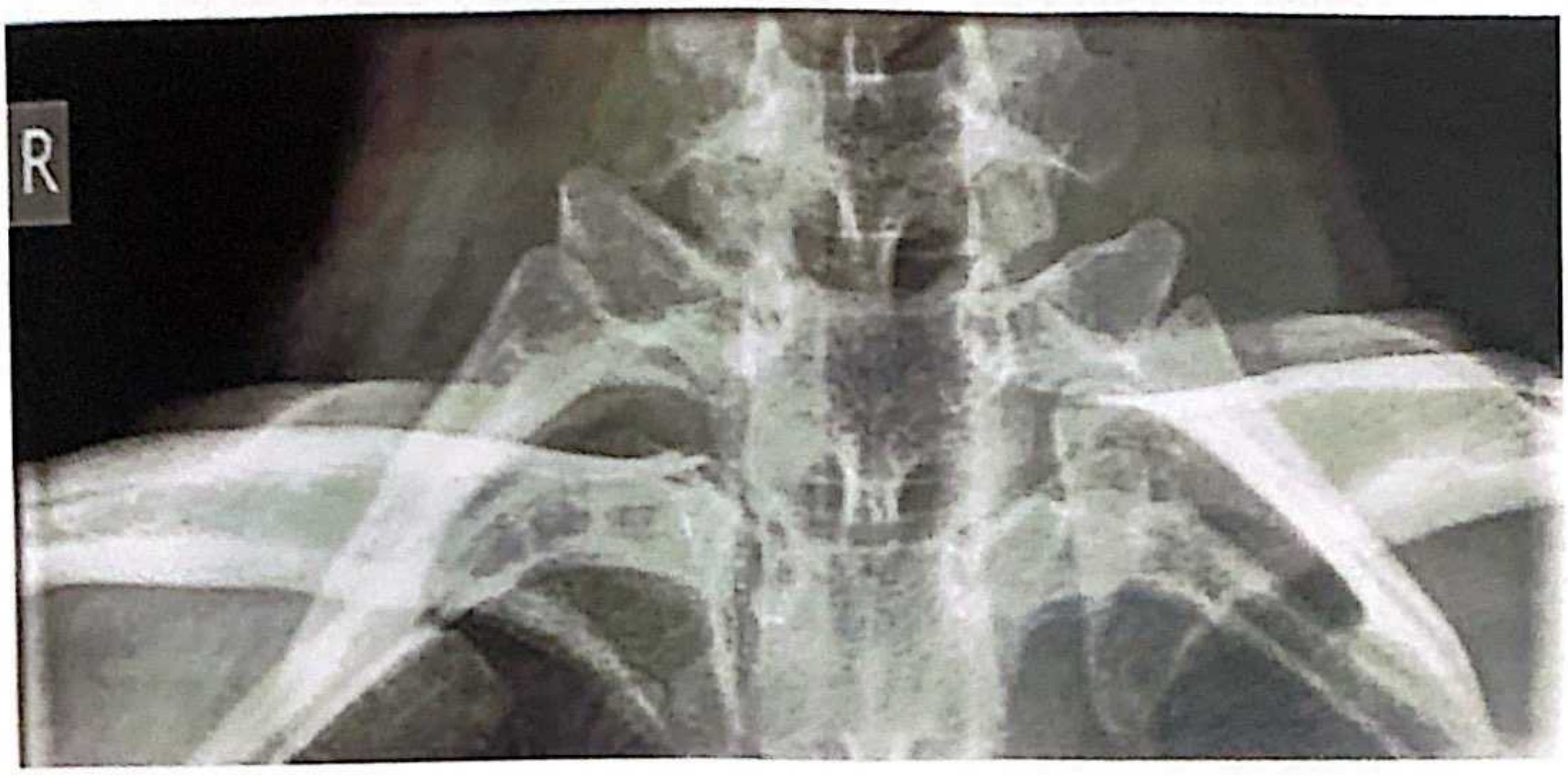


AP shoulder. Internal rotation humerus. Greater tubercle (*arrows*); lesser tubercle in profile (*arrowhead*).



AP shoulder. External rotation humerus. Greater tubercle (*arrow*).

Q.20) Identify?



Identify the view: AP Radiograph of Sternoclavicular joint
Serendipity view

Positioning: The patient is supine on the radiographic examination table

Centring: At the level of the sternoclavicular joint with a 40-degree cephalic angle

Indications: When suspecting dislocations of the sternoclavicular joint

Diagnosis: Widening and displacement of the left sternoclavicular joint. Sternoclavicular joint dislocation

What next:

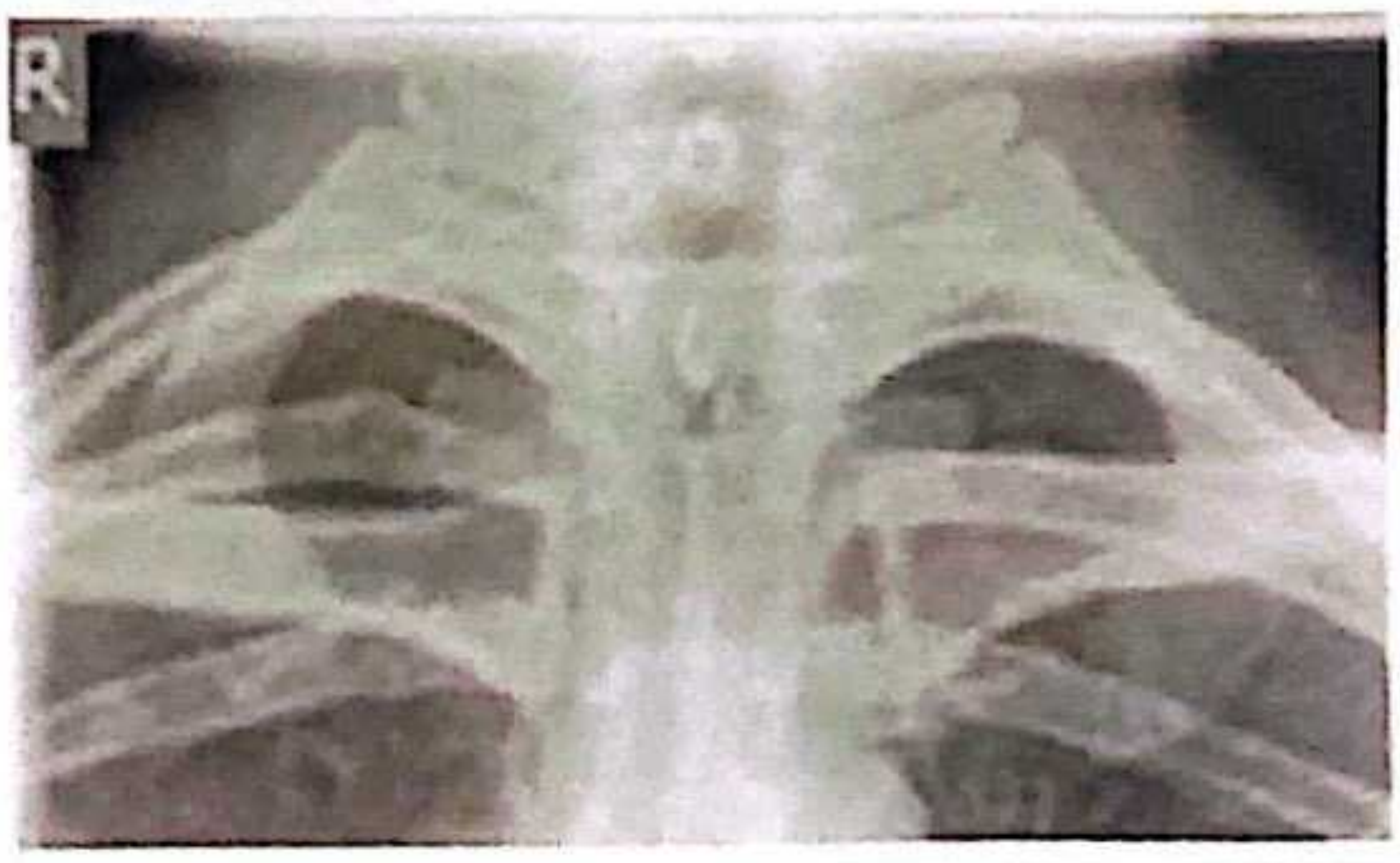
CT

1. Joint space widening and asymmetry at the sternoclavicular joint
2. Associated injuries of the mediastinum

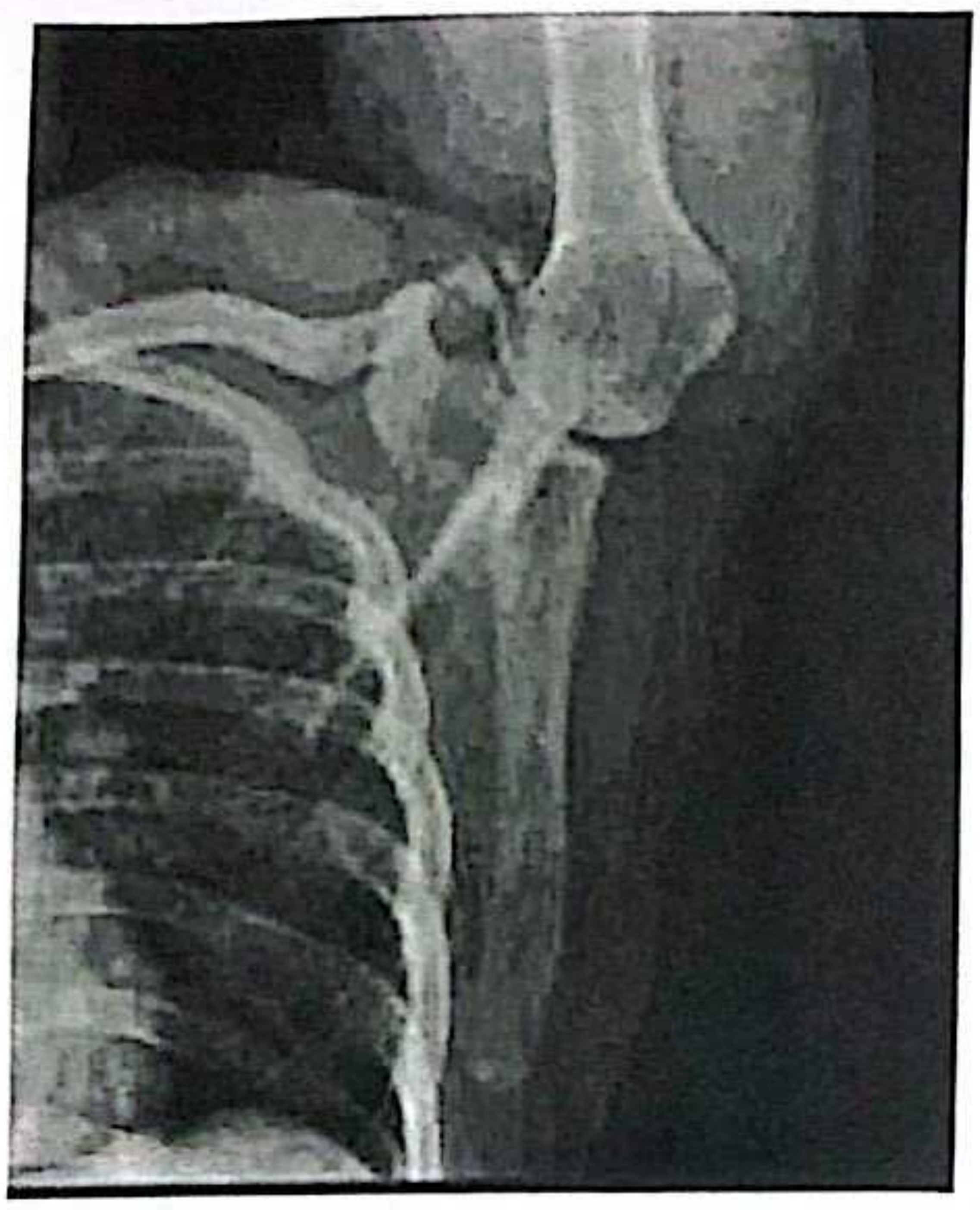
Treatment:

1. Conservative treatment, especially for anterior dislocation.
2. Posterior dislocations are normally treated with closed reduction.
3. Surgical fixation (ORIF) is usually reserved for unreduced posterior dislocations

Frontal View



Q.21) Identify?



Identify the view: Shoulder AP Radiograph Stryker notch view

Positioning:

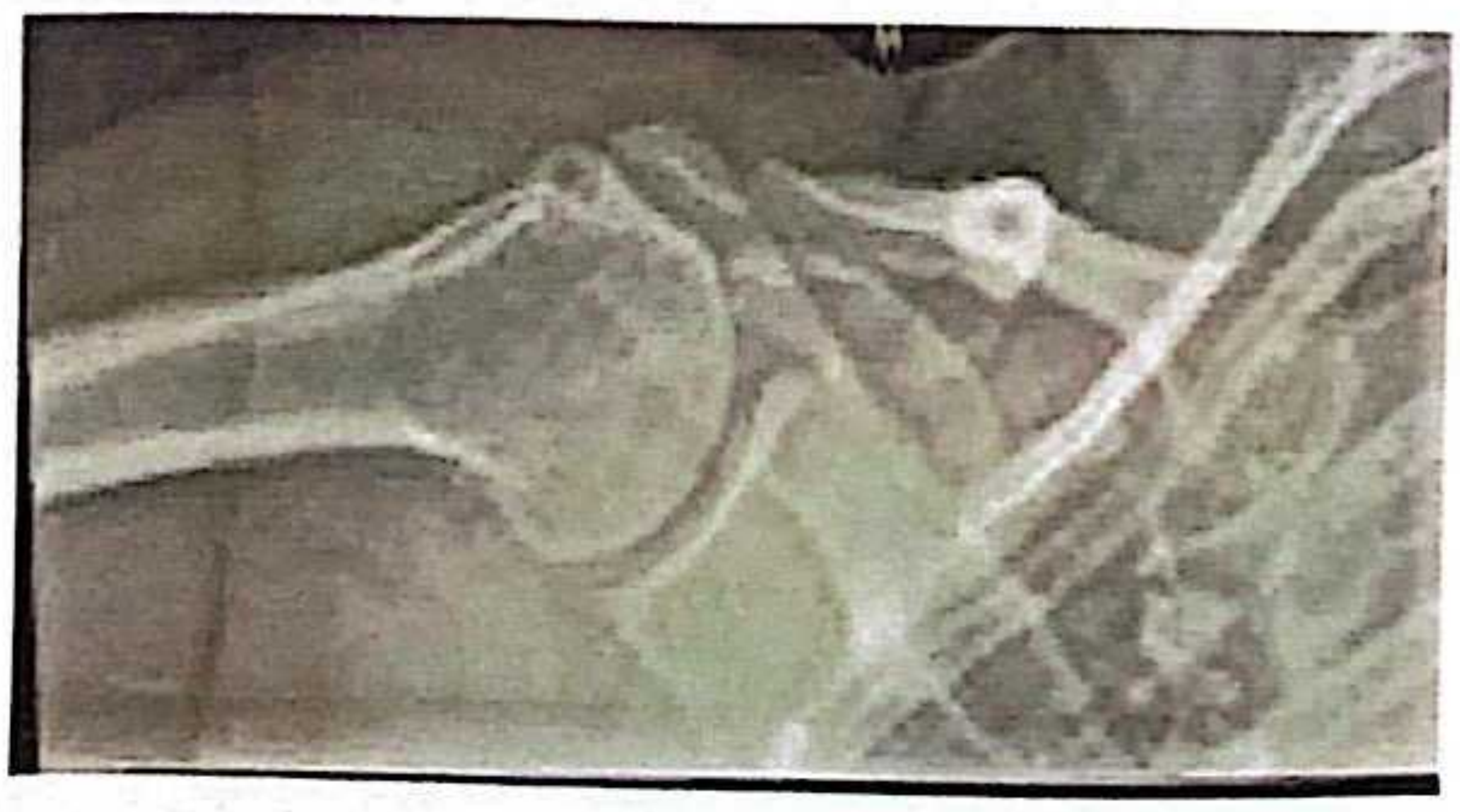
1. Patient is preferably erect
2. The midcoronal plane of the patient is parallel to the image receptor: the patient's back is against the image receptor
3. The glenohumeral joint of the affected side is at the centre of the image receptor
4. The patient is turned toward the affected side to show the glenohumeral joint space; this is achieved by rotating the patient 30-45°
5. Affected arm is abducted anteriorly and rested on the patient's head while maintaining internal rotation (if possible)

Centring:

1. 10-15 degree cephalad angle of the x-ray tube
2. Mid-axilla at the level of the glenohumeral/shoulder joint

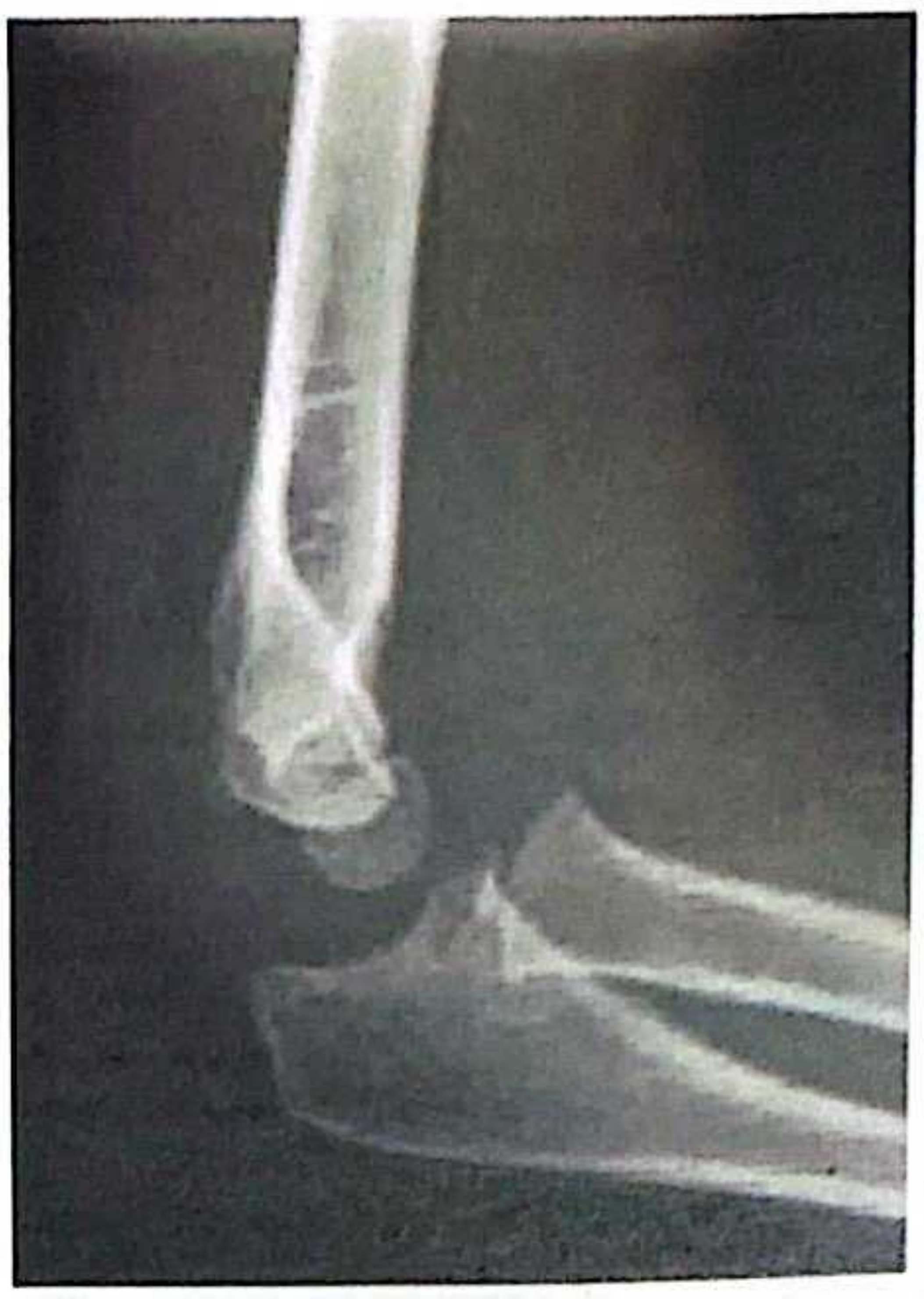
Indications:

1. Evaluate the articulation of the glenoid and the humeral head
2. Hill-Sachs lesions



Stryker notch view patient unable to abduct. There is a loss of the subacromial space, suggesting subacromial impingement.

Q.22) Identify?

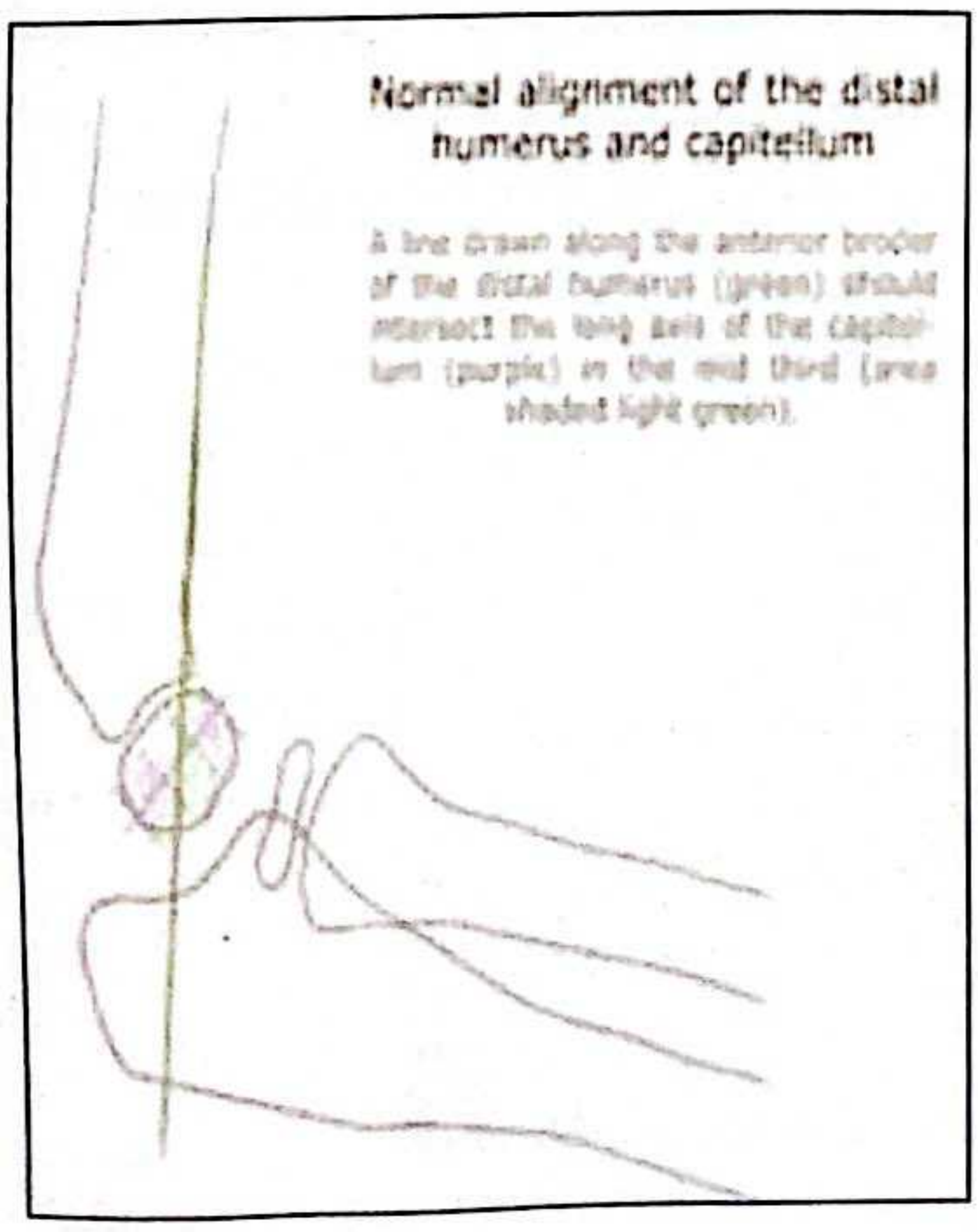


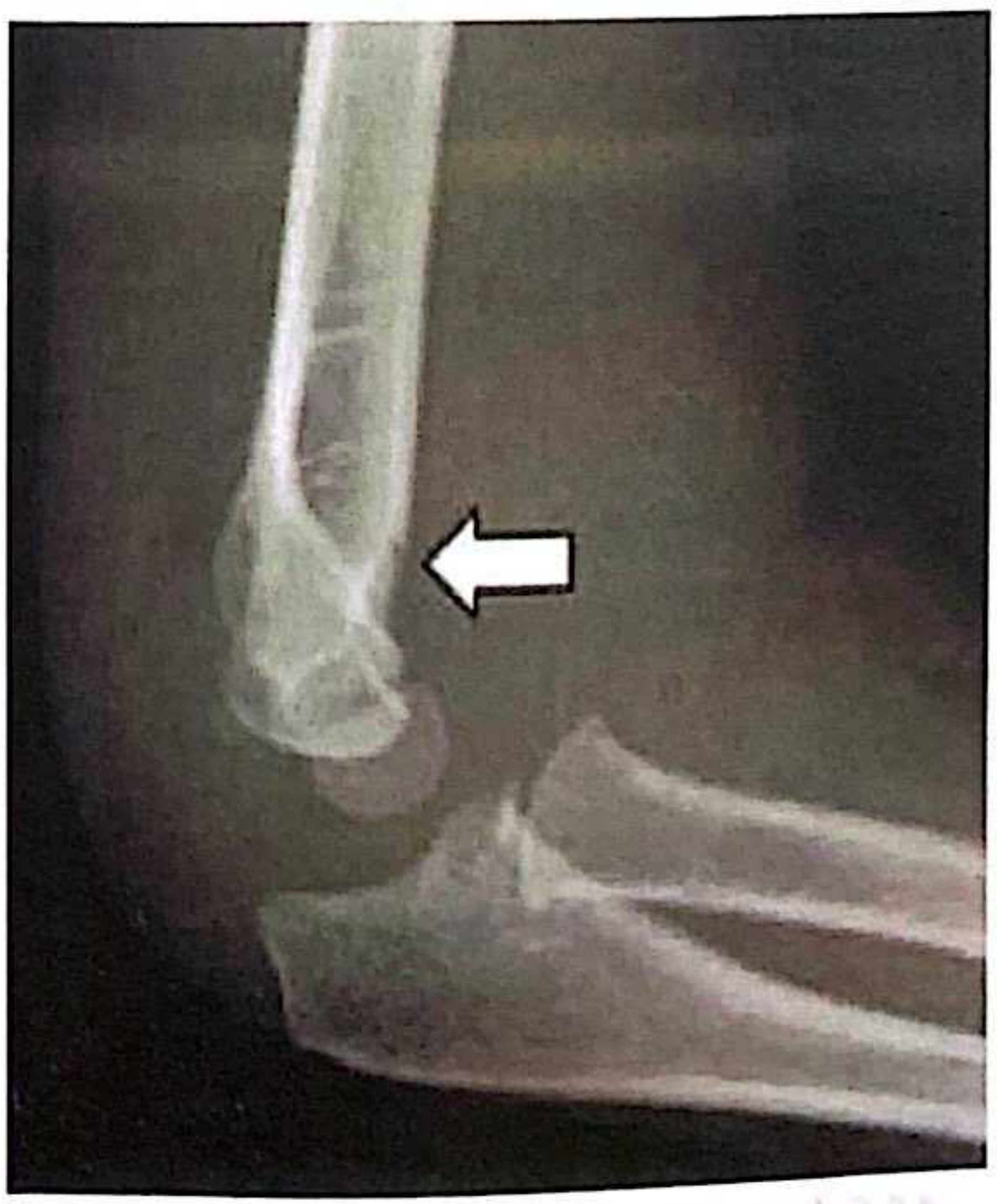
Identify the view: AP Radiograph of humerus supracondylar view
Positioning: Patient stands facing the X-ray tube with the posterior aspect of arm in contact with cassette (placed on a vertical stand)
Centring:

1. Centred between medial and lateral epicondyle
2. This can be achieved with partial or full flexion of the elbow

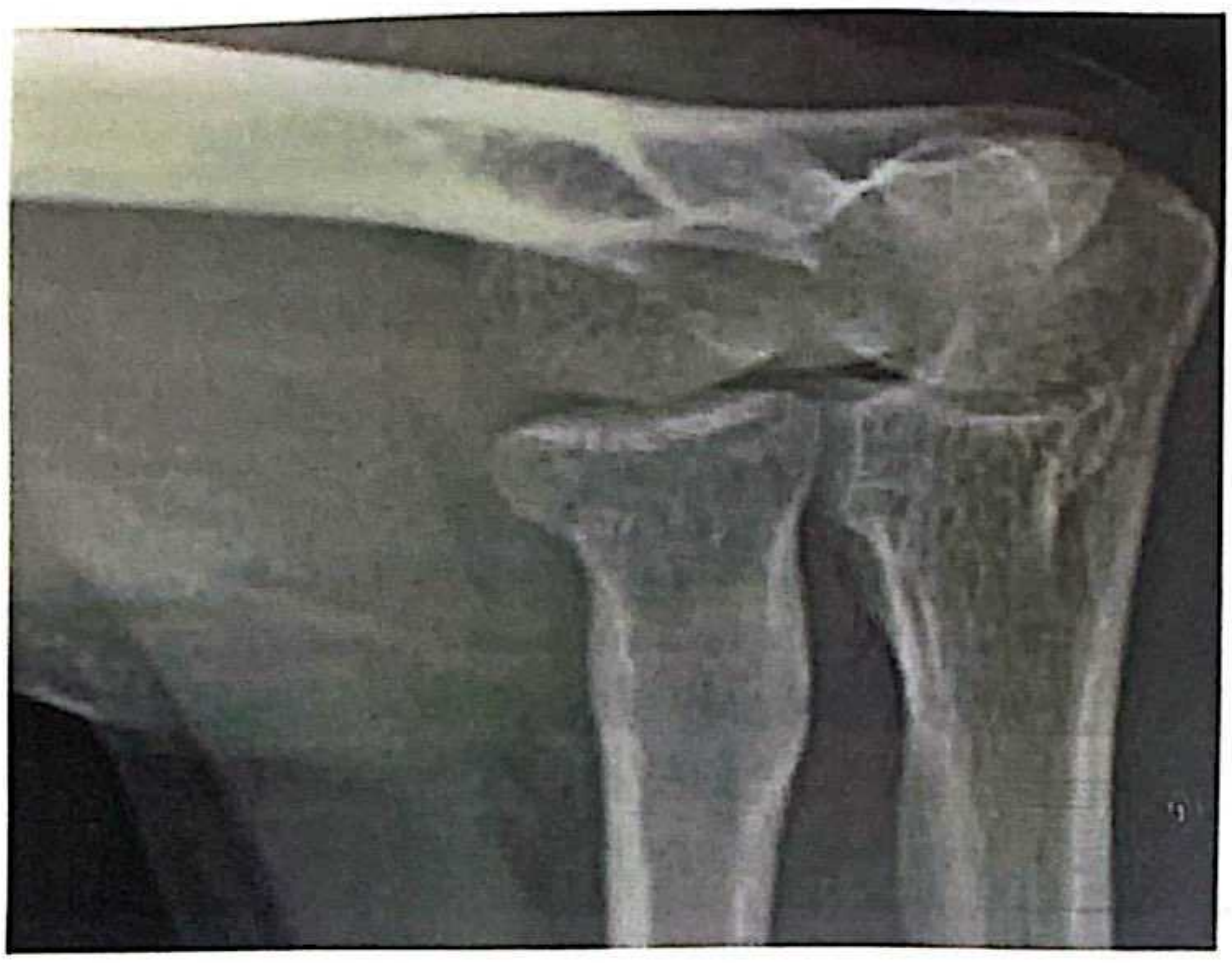
Indications: Supracondylar fractures

Describe:
A joint effusion with sail sign and an anterior cortical supracondylar breach is present.
Anterior cortical breach indicated by white arrow. Anterior humeral line continues to intersect the mid-point of the capitellum.
Diagnosis: Supracondylar fracture


Normal alignment of the distal humerus and capitellum
A line drawn along the anterior broder of the distal humerus (green) should intersect the long axis of the capitellum (purple) in the mid third (area shaded light green).



Q.23) Identify?



Identify the view: Axial Projection Radiograph of the elbow Coyle's view

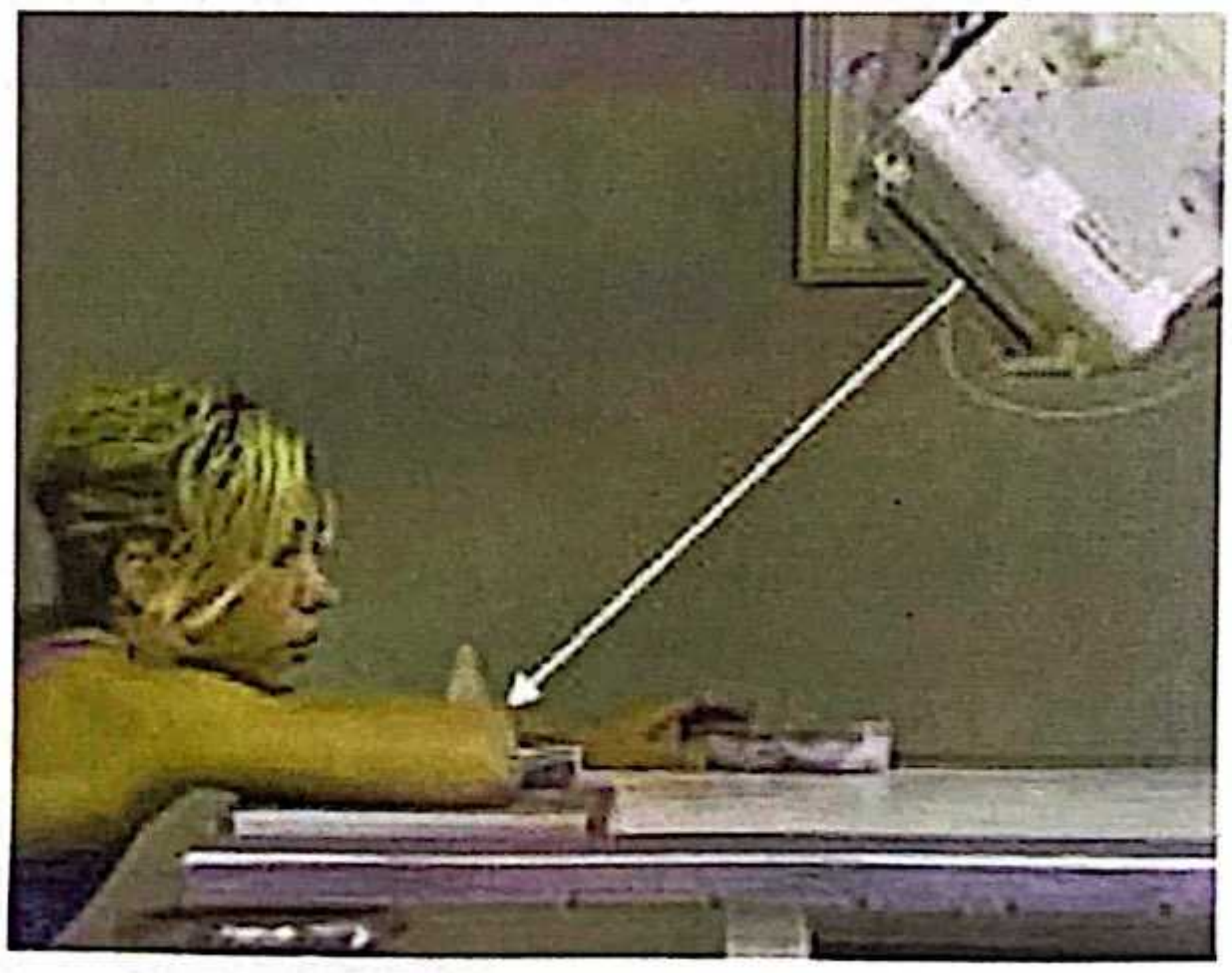
Positioning:

1. Patient is sitting next to the table
2. At 90 degrees elbow flexion, the medial border of the palm and forearm are kept in contact with the tabletop
3. The shoulder, elbow and wrist are kept in the same horizontal plane
4. Rotate the hand so the thumb is pointing towards the ceiling, ensuring all aspects of the arm from the wrist to the humerus are in the same plane
5. The beam is angled roughly 45 degrees towards the long axis of the humerus

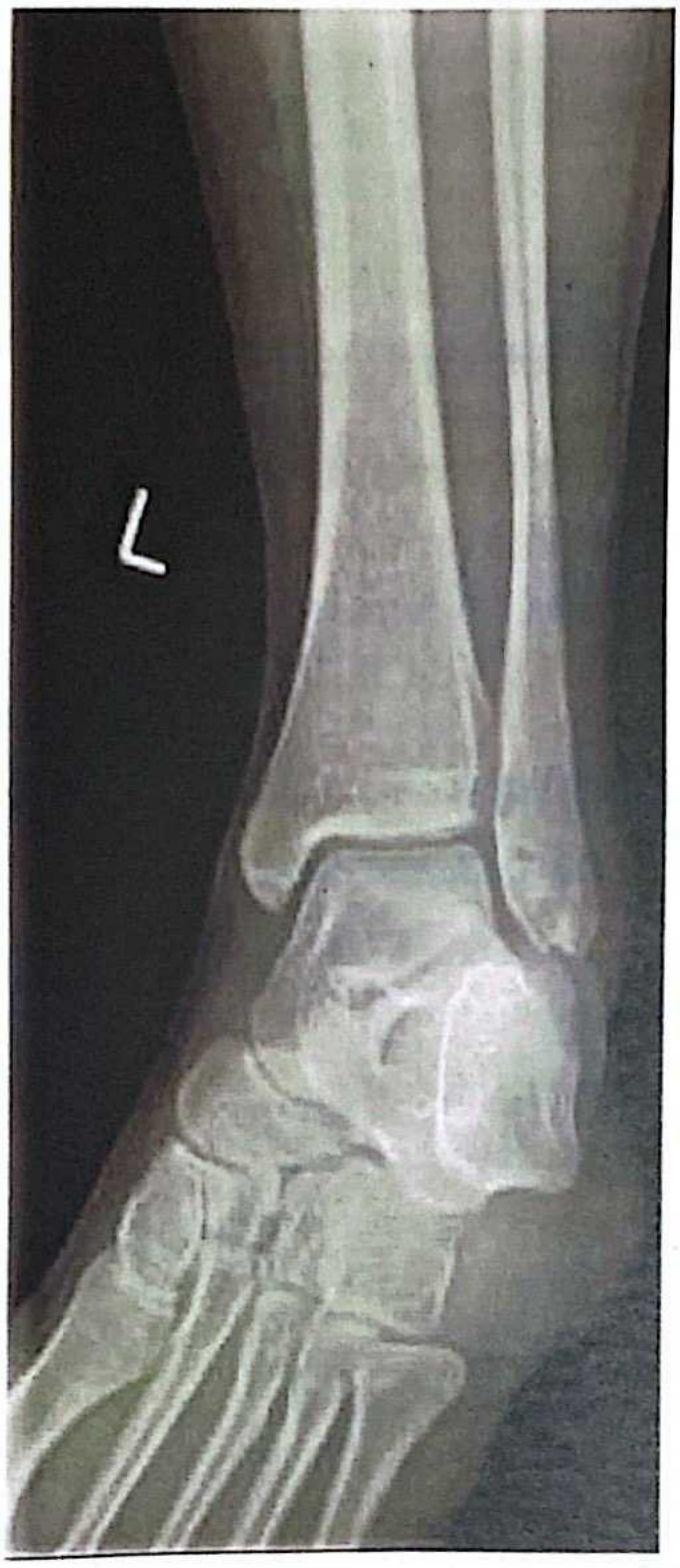
Centring: The radial head

Indications: Suspicion of a radial head fracture

Diagnosis: Non-displaced radial head fracture was revealed.



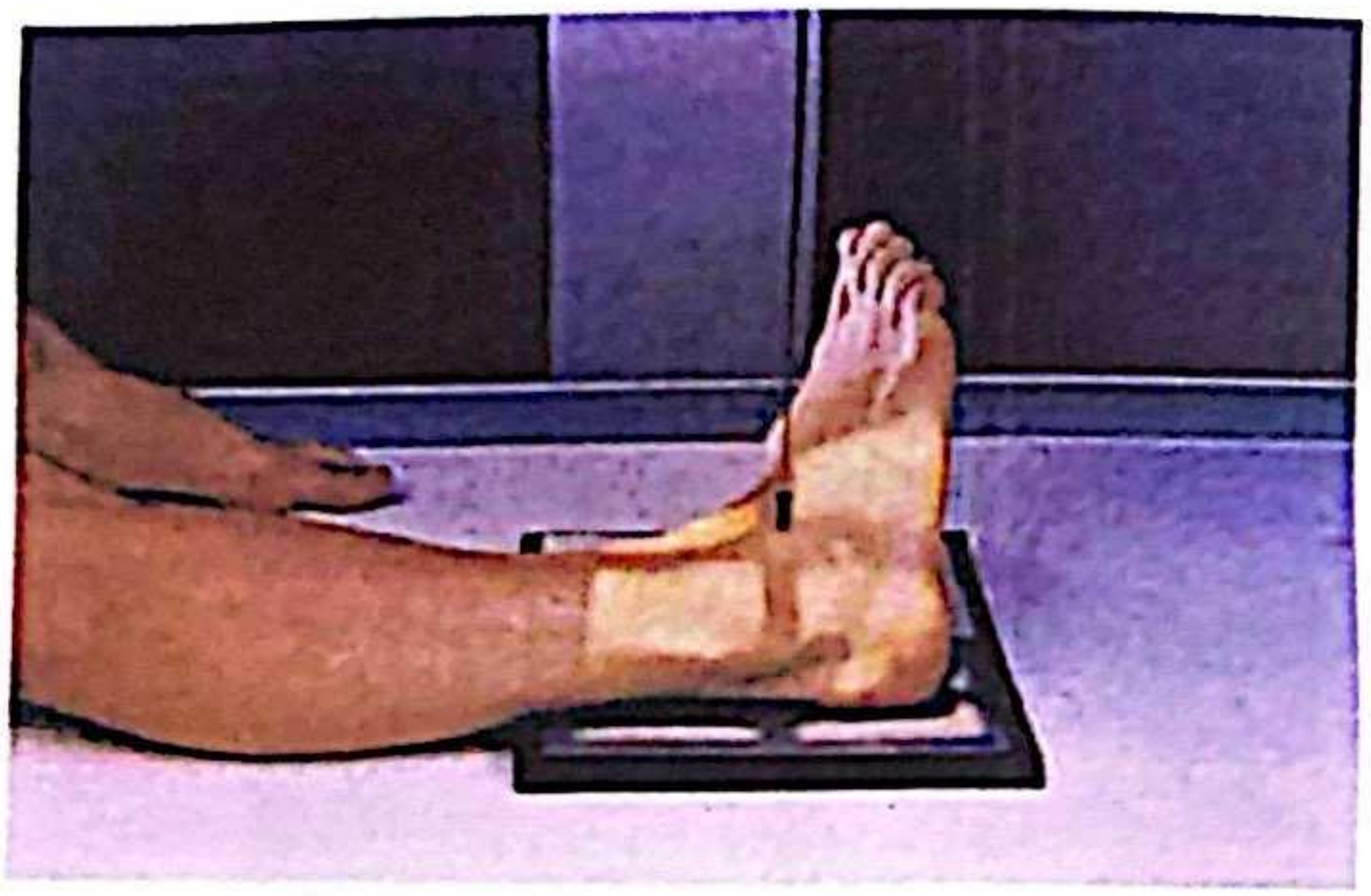
Q.24) Identify?



Identify the view: AP Radiograph Ankle mortise view

Positioning:

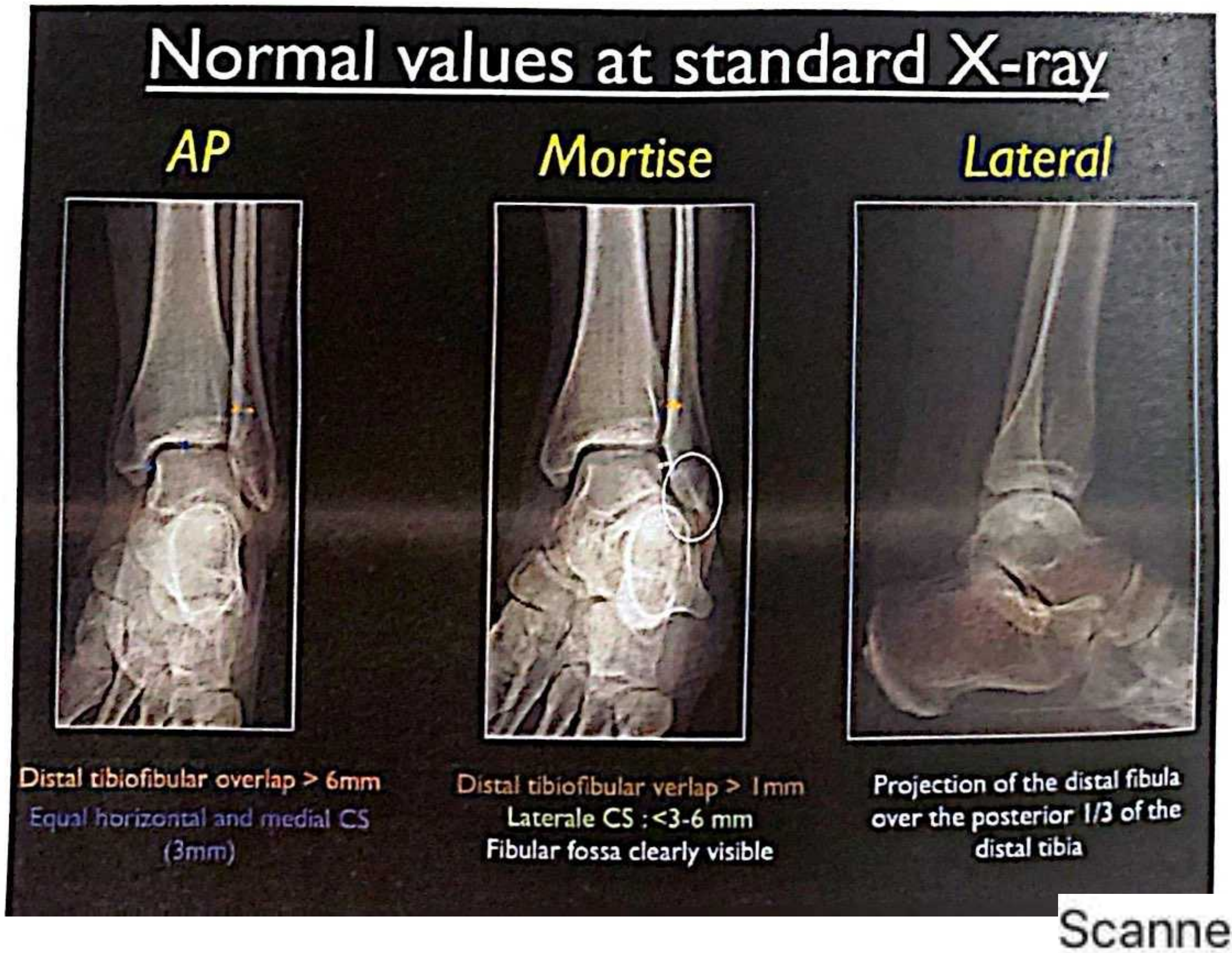
1. The patient may be supine or sitting upright with the leg straightened on the table
2. The leg must be rotated internally 15° to 20°, thus aligning the intermalleolar line parallel to the detector. This usually results in the 5th toe being directly in line with the centre of the calcaneum
3. Internal rotation must be from the hip; isolated rotation of the ankle will result in a non-diagnostic image
4. Foot should be in slight dorsiflexion



Centring: The midpoint of the lateral and medial malleoli (10mm above malleoli)

Indications:

Assessing the articulation of the tibial plafond and two malleoli with the talar dome



Normal values at standard X-ray

AP

Mortise

Lateral

Distal tibiofibular overlap > 6mm
Equal horizontal and medial CS (3mm)

Distal tibiofibular verlap > 1mm
Laterale CS : <3-6 mm
Fibular fossa clearly visible

Projection of the distal fibula over the posterior 1/3 of the distal tibia

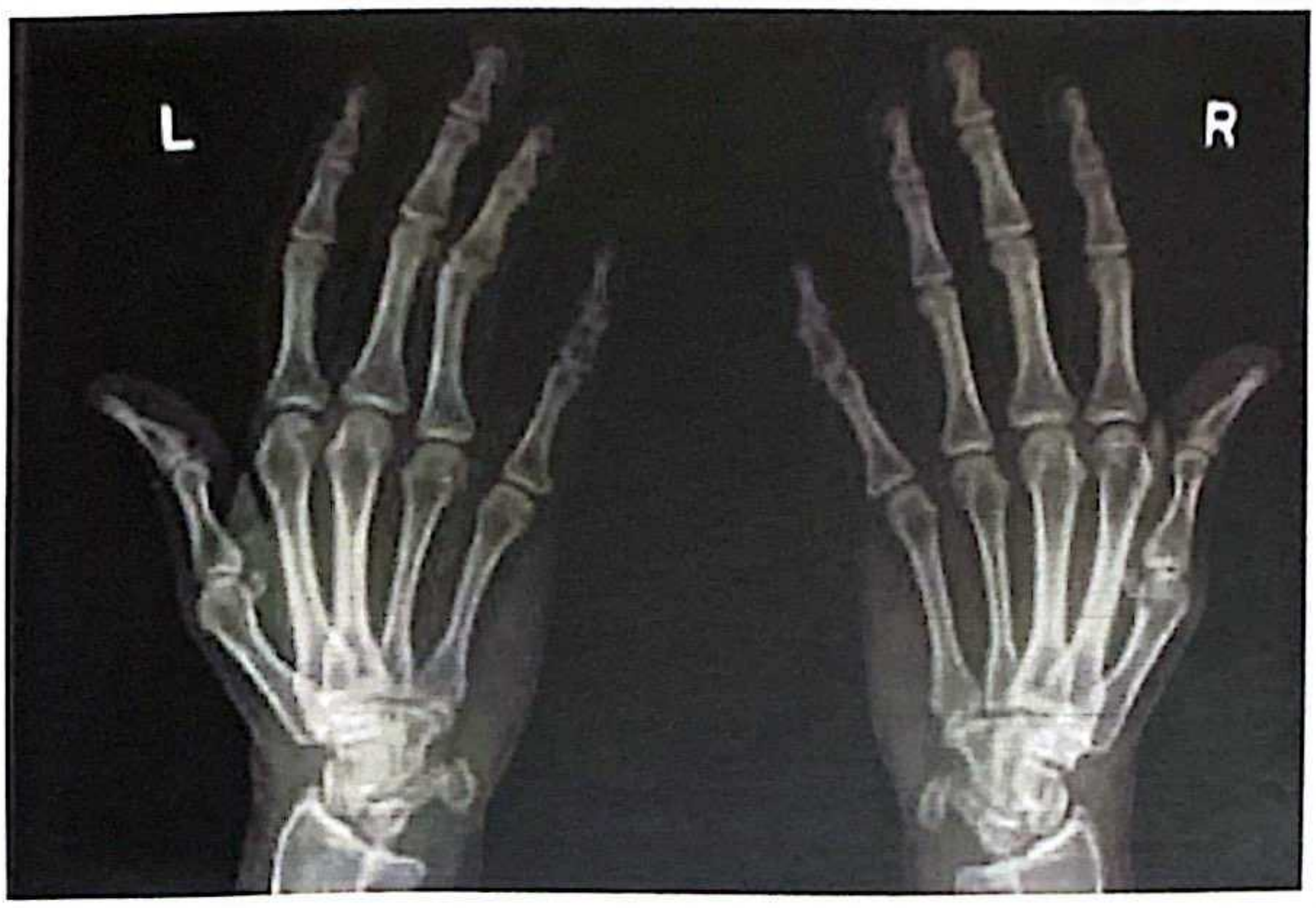
Q.25) Identify?

Identify the view: P
catcher view or post
Positioning:
1. Patient may b
2. Both hands a
   placed on the
3. The hands ar
   assume a pos
   ball

Centring: Between
metacarpophalange
Indications:
1. Signs of rheu
2. Clinodactyly

Diagnosis: Bilateral
normal, There is no

Q.25) Identify?



Identify the view: Plain Radiograph Norgaard projection ball-catcher view or posterior oblique view of both hands.

Positioning:

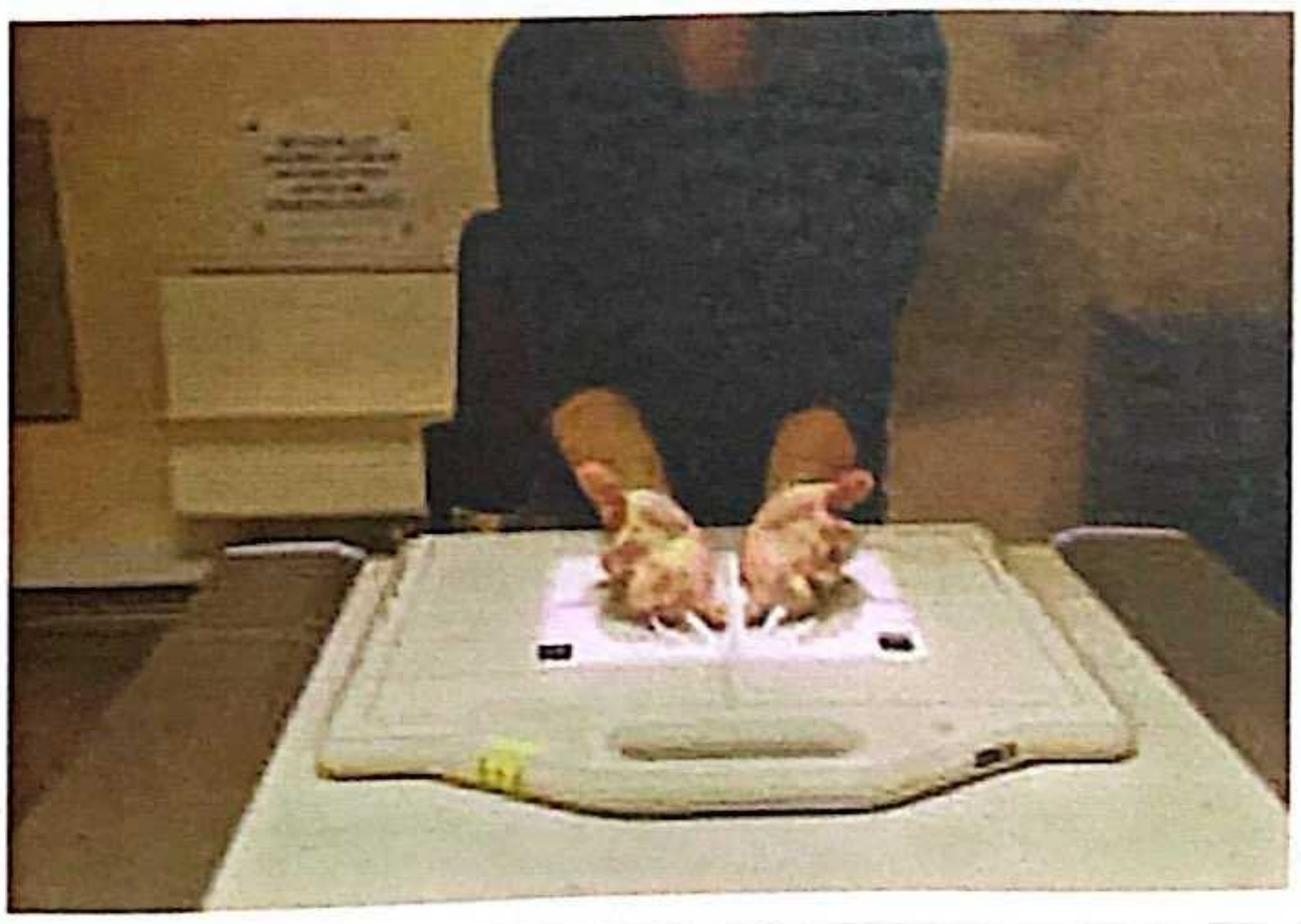
1. Patient may be seated alongside or facing the table
2. Both hands are supinated with their dorsal surfaces are placed on the cassette/fpds
3. The hands are then rotated medially by 45 degrees to assume a position likened to one about to receive or catch a ball

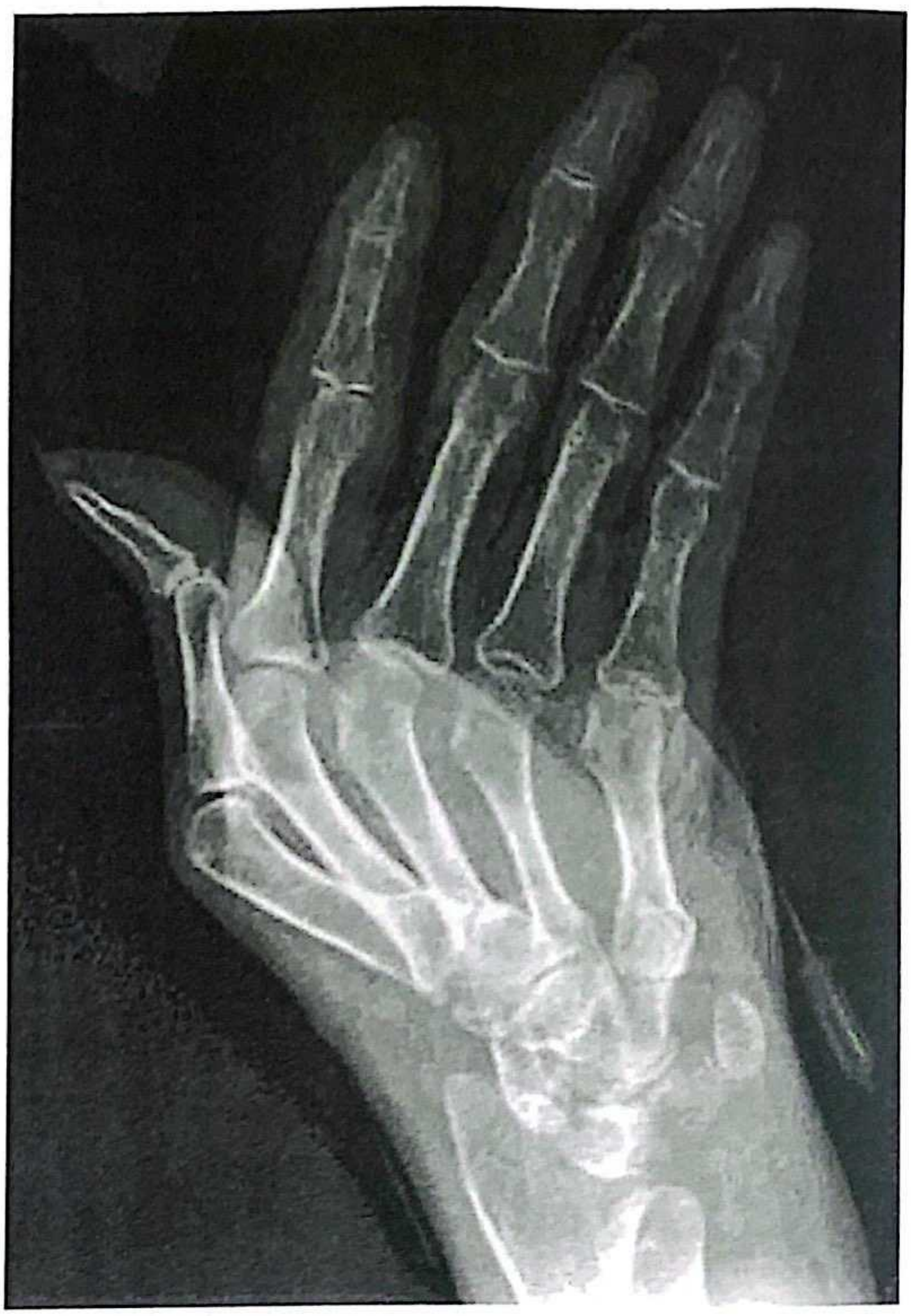
Centring: Between the two hands at the level of the metacarpophalangeal joints

Indications:

1. Signs of rheumatoid arthritis.✓
2. Clinodactyly ✓

Diagnosis: Bilateral clinodactyly is evident. Bony alignment is normal, There is no evidence of periarticular erosion.





Radiographs of the hands, including Norgaard (ball-catcher's) views. There are multiple typical findings in SLE arthropathy, including

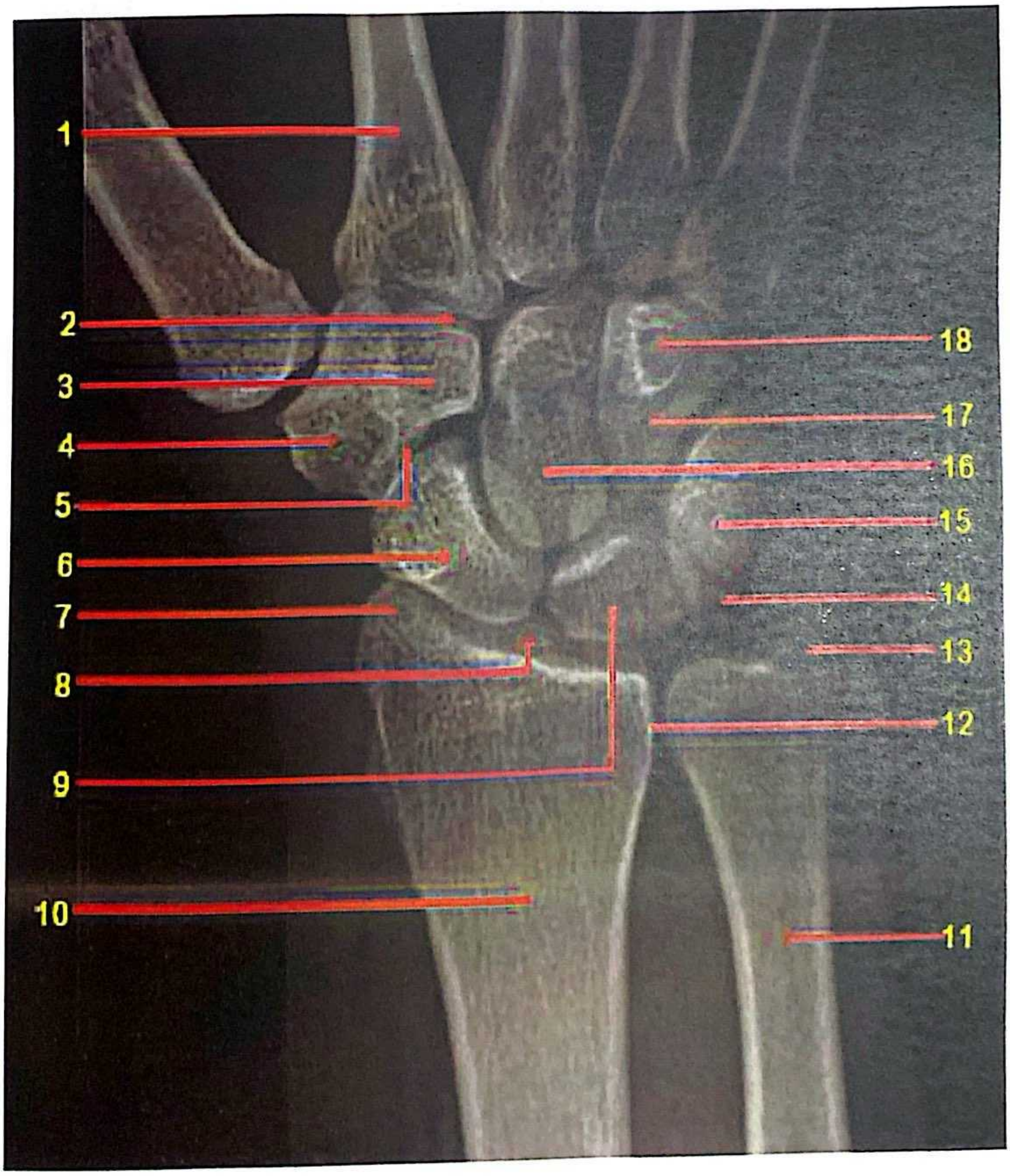
1. marked contractures and subluxations in a bilateral symmetric pattern
2. swan neck deformities, particularly in the right hand
3. hooked heads of the second and third metacarpals
4. juxta-articular osteopaenia
5. no erosions
6. no soft tissue calcifications

Wrist PA

Positioning: Upper extremity in same horizontal plane, flex elbow 900 pronate hand, cup hand & place carpal in contact with the cassette

Centring: Perp.to midcarpal area

How to identify: Ulnar styloid medially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1. Metacarpal bone	2. Carpometacarpal joint	3. Trapezoid
4. Trapezium	5. Scapho-trapezio-trapezoid (STT) joint	6. Scaphoid
7. Styloid process of radius	8. Radiocarpal joint	9. Lunate
10. Radius	11. Ulna	12. Distal radioulnar joint
13. Styloid process of Ulna	14. Triquetrum	15. Pisiform
16. Capitate	17. Hamate	18. Hook of the hamate.

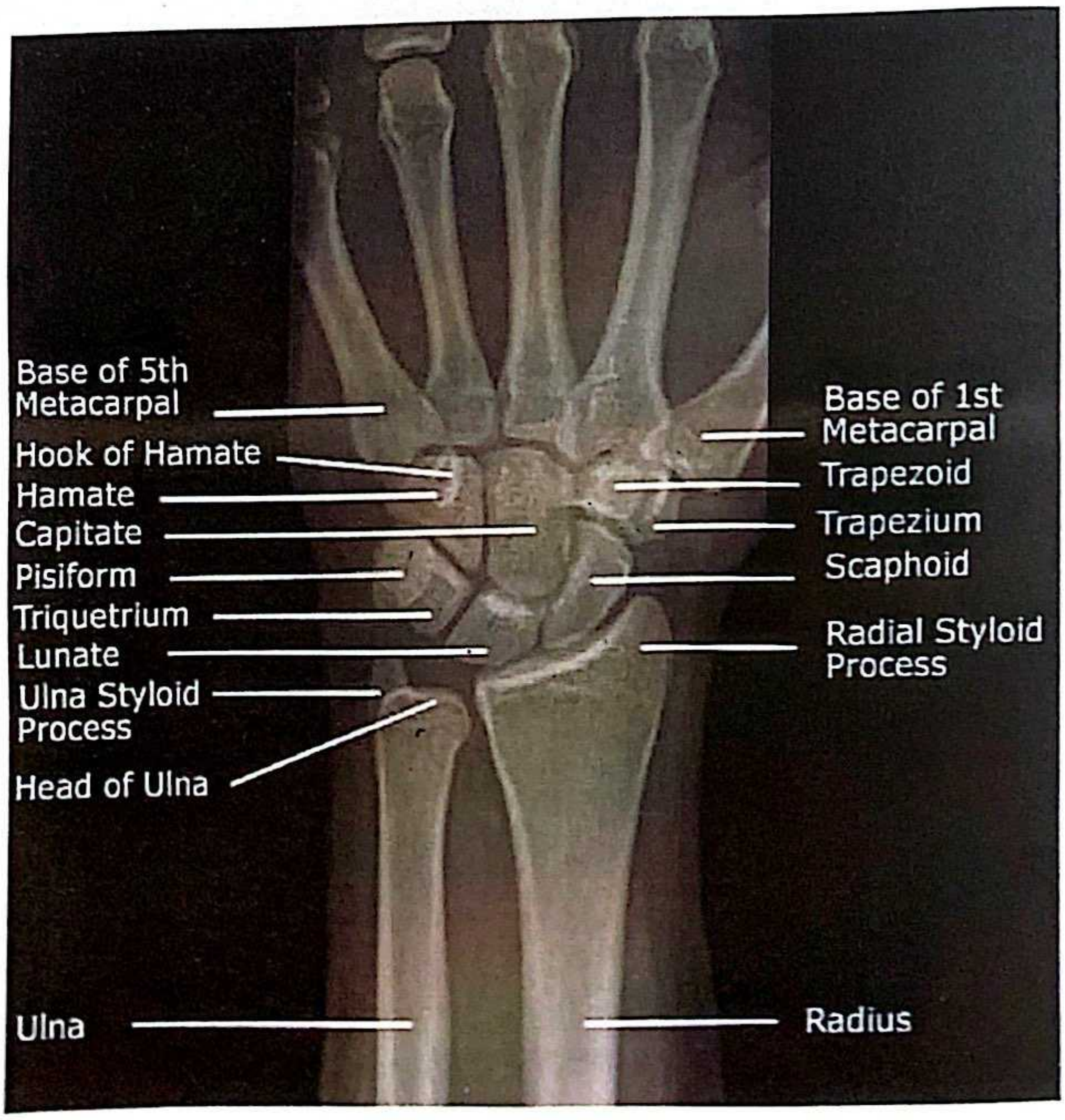
Wrist AP

Distal ulna

Positioning: Upper extremity in same horizontal plane, extend elbow, supinate hand, elevate extended fingers to place elbow in contact with the cassette

Centring: Perp.to midcarpal area

How to identify: Ulnar styloid centrally near lunate


Base of 5th Metacarpal
Hook of Hamate
Hamate
Capitate
Pisiform
Triquetrium
Lunate
Ulna Styloid Process
Head of Ulna
Ulna
Base of 1st Metacarpal
Trapezoid
Trapezium
Scaphoid
Radial Styloid Process
Radius

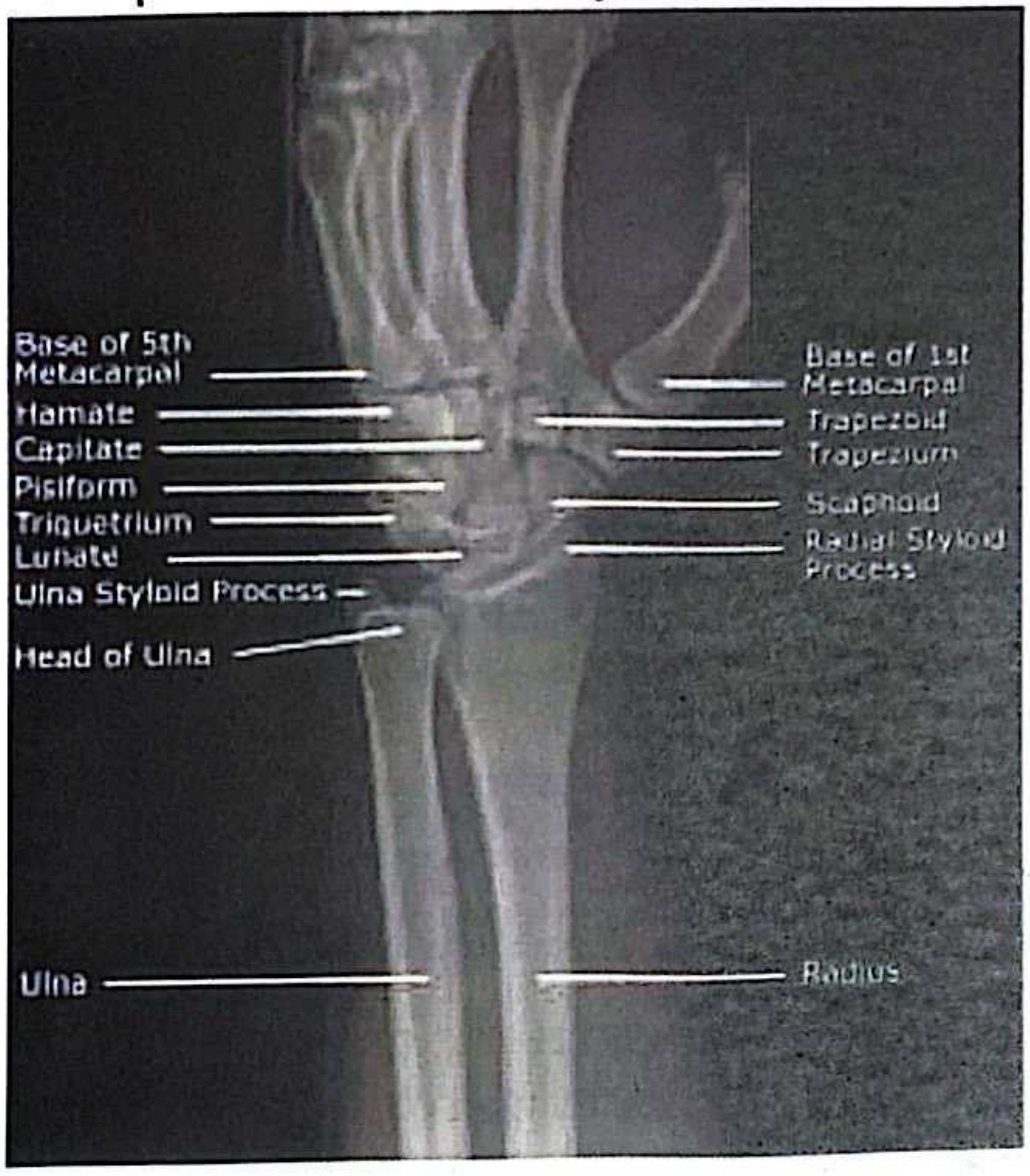
Wirst PA oblique internal rotation

Scaphoid

Positioning: Upper extremity in same horizontal plane, flex elbow 900 with wrist & hand rotated 450 externally from prone

Centring: Perpendicular to mid carpal area

How to identify: Scaphoid seen clearly without hand deviation


Base of 5th Metacarpal
Hamate
Capitate
Pisiform
Triquetrium
Lunate
Ulna Styloid Process
Head of Ulna
Ulna
Base of 1st Metacarpal
Trapezoid
Trapezium
Scaphoid
Radial Styloid Process
Radius

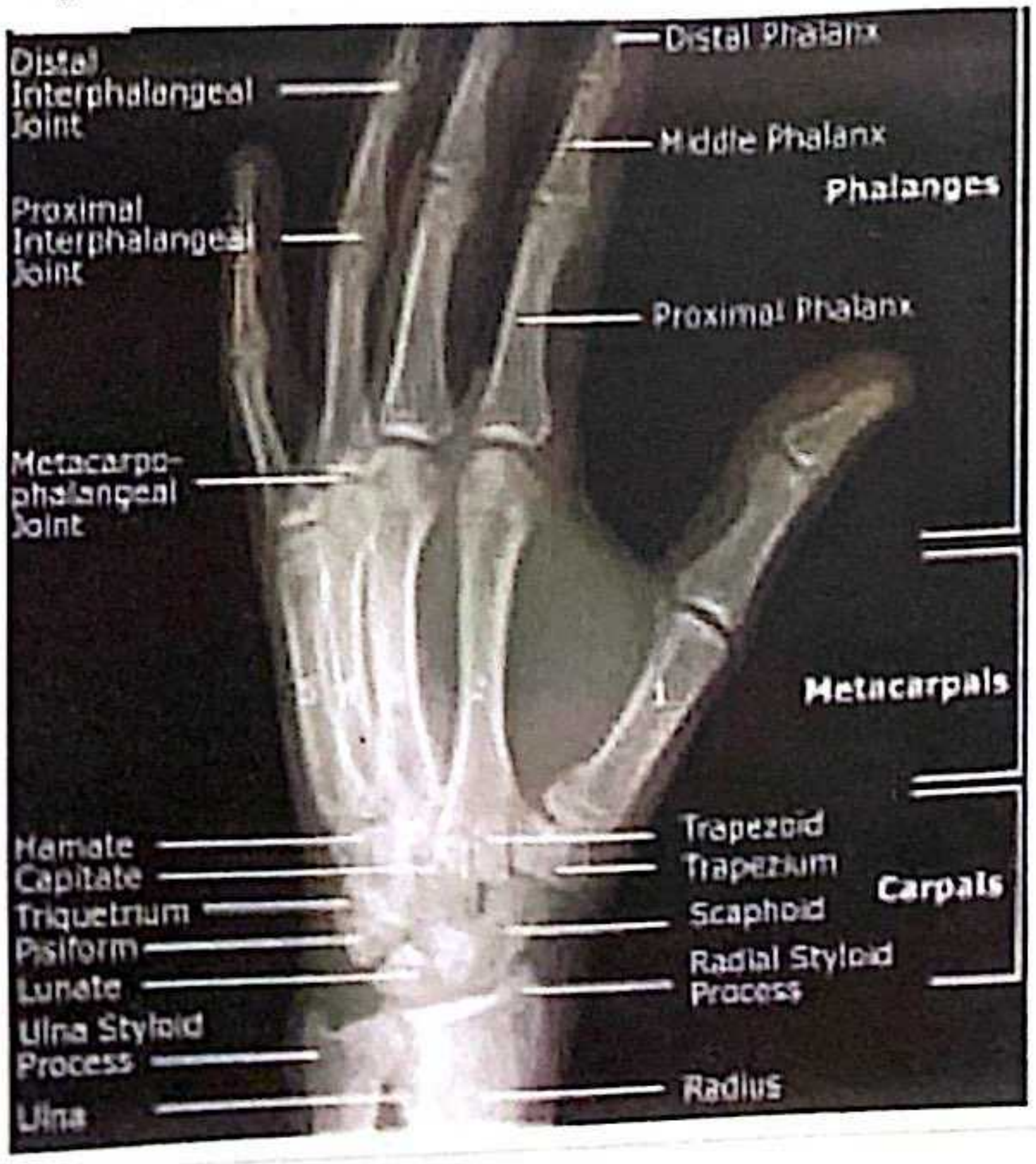
Wrist PA oblique external rotation

Psisform fracture

Positioning: Upper extremity in same horizontal plane, flex elbow 900 & rotate wrist & hand 450 internally from prone

Centring: Perp.to mid carpal area

Pisiform seen clearly

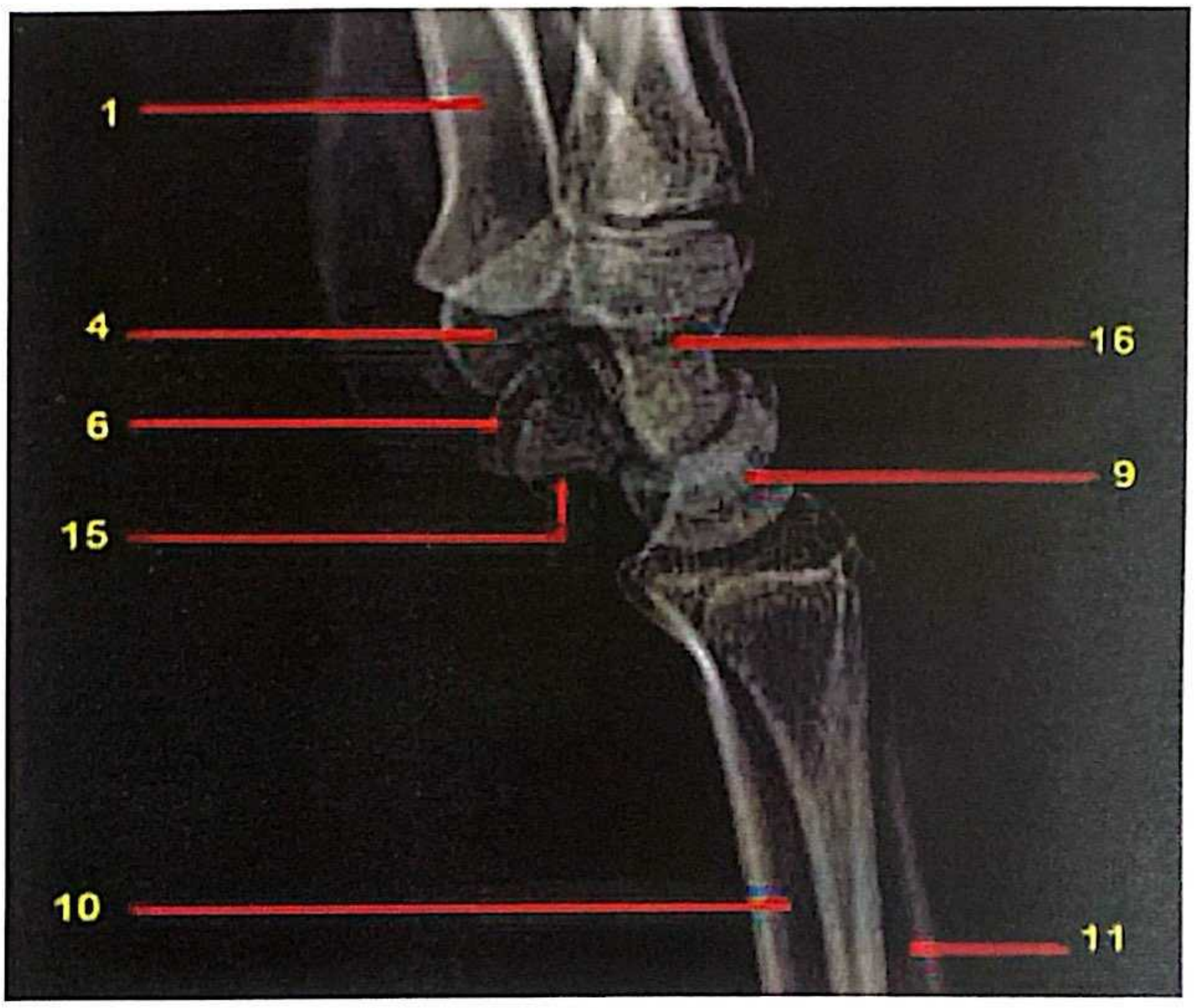

Distal Interphalangeal Joint
Distal Phalanx
Middle Phalanx
Phalanges
Proximal Interphalangeal Joint
Proximal Phalanx
Metacarpo-phalangeal Joint
Metacarpals
Hamate
Capitate
Triquetrium
Pisiform
Lunate
Ulna Styloid Process
Ulna
Trapezoid
Trapezium
Scaphoid
Carpals
Radial Styloid Process
Radius

Wrist lateral

Lunate & perilunate dislocation

Positioning: Upper extremity in same horizontal plane, flex elbow 900 & hand in lateral position

Centring: Perpendicular to midcarpal area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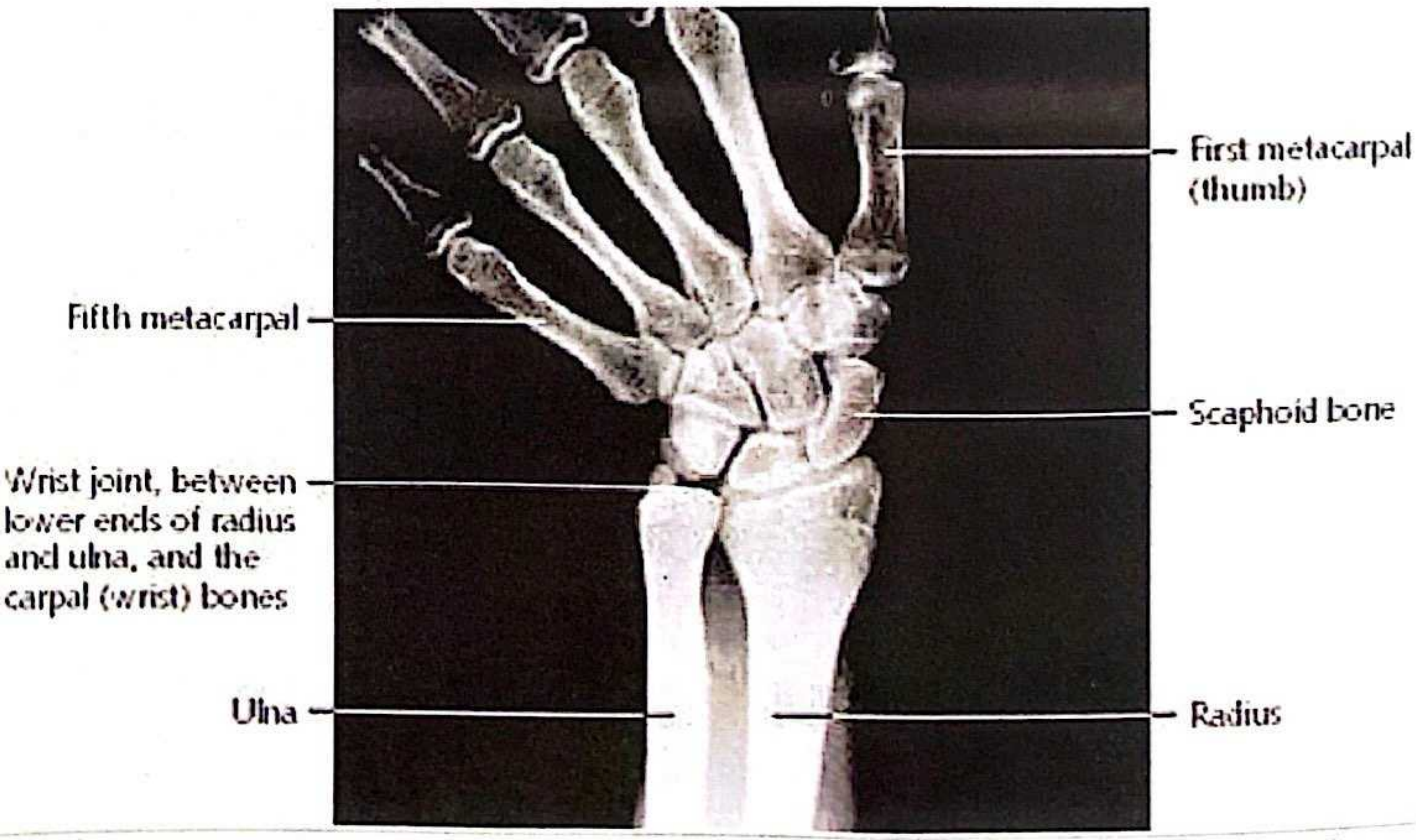
Wrist ulnar fexion

Scaphoid Fracture

Positioning: Upper extremity in same horizontal plane, flex elbow 900 & pronate hand, evert hand as far as possible

Centring: Perpendicular to mid carpal area


First metacarpal (thumb)
Fifth metacarpal
Scaphoid bone
Wrist joint, between lower ends of radius and ulna, and the carpal (wrist) bones
Ulna
Radius

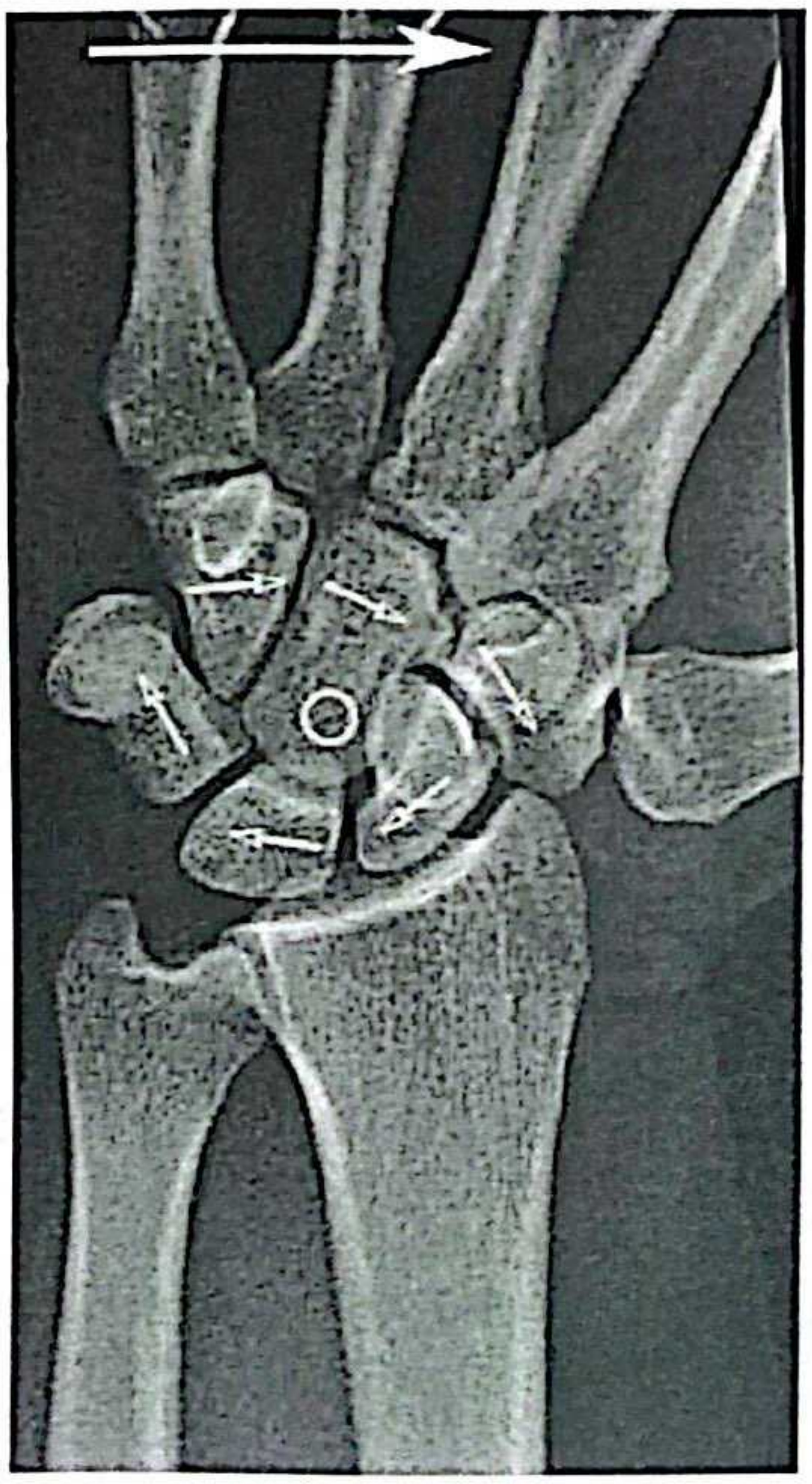
Wrist radial flexion

Lunate, triquetral, pisiform & hamate Fracture

Love & try party hard

Positioning: Upper extremity in same horizontal plane, flex elbow 900 & pronate hand, invert hand as far as possible

Centring: Perpendicular to mid carpal area

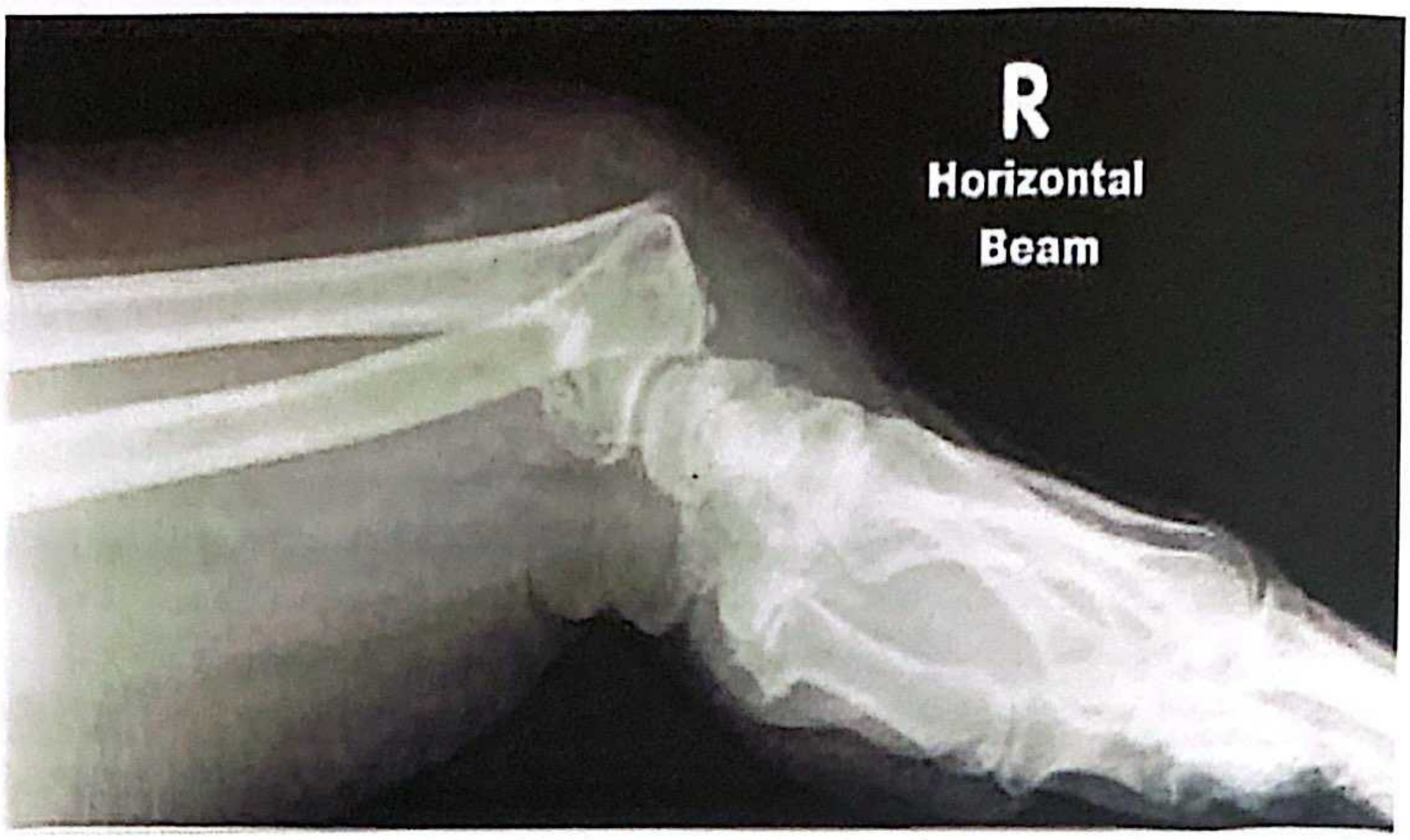


Wrist (horizontal beam lateral view)

Positioning:

1. Patient is supine
2. Affected arm is placed by the patient's side on a pillow or foam block
3. Image receptor is placed leaning against the afore mentioned foam block or pillow with the long axis of the image receptor in line with the long axis of the affected limb

Centring: The ulnar aspect of the mid carpal region



A transverse fracture of the distal radius with radial and volar offset of the distal fragment. There is also an avulsion fracture of the ulnar styloid.
The first carpometacaropal joint has severe degenerative changes.

Wrist (carpal tunnel view)
(2018)

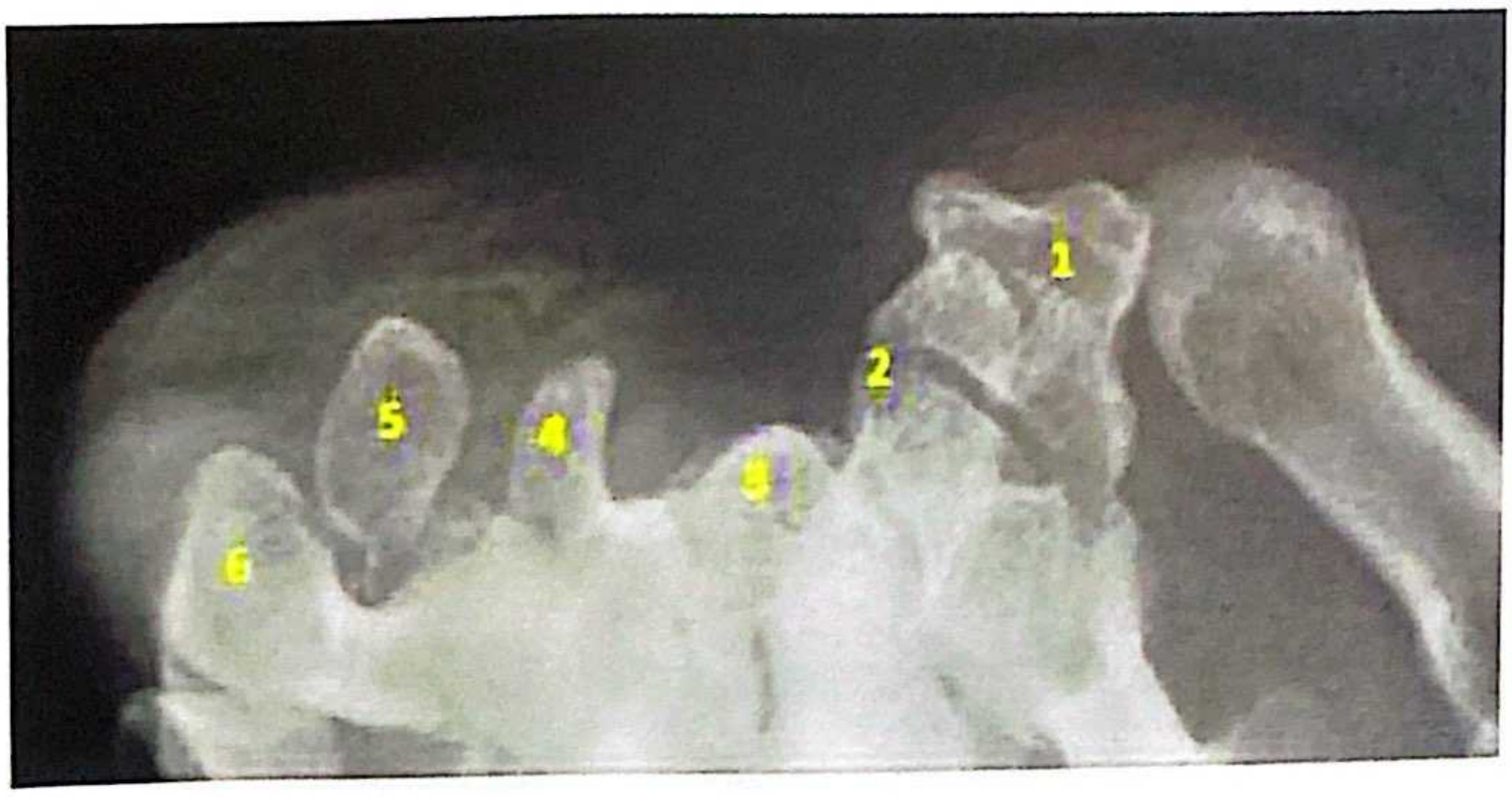
It can be utilised to investigate potential hook of hamate, pisiform and trapezium factures.

Positioning:

1. Patient stands with the back facing the table
2. Palmar surface of hand is placed in contact with the cassette which is placed at the table margin
3. Wrist is dorsiflexed approximately 135º, making the carpals and metacarpals lift away from the cassette

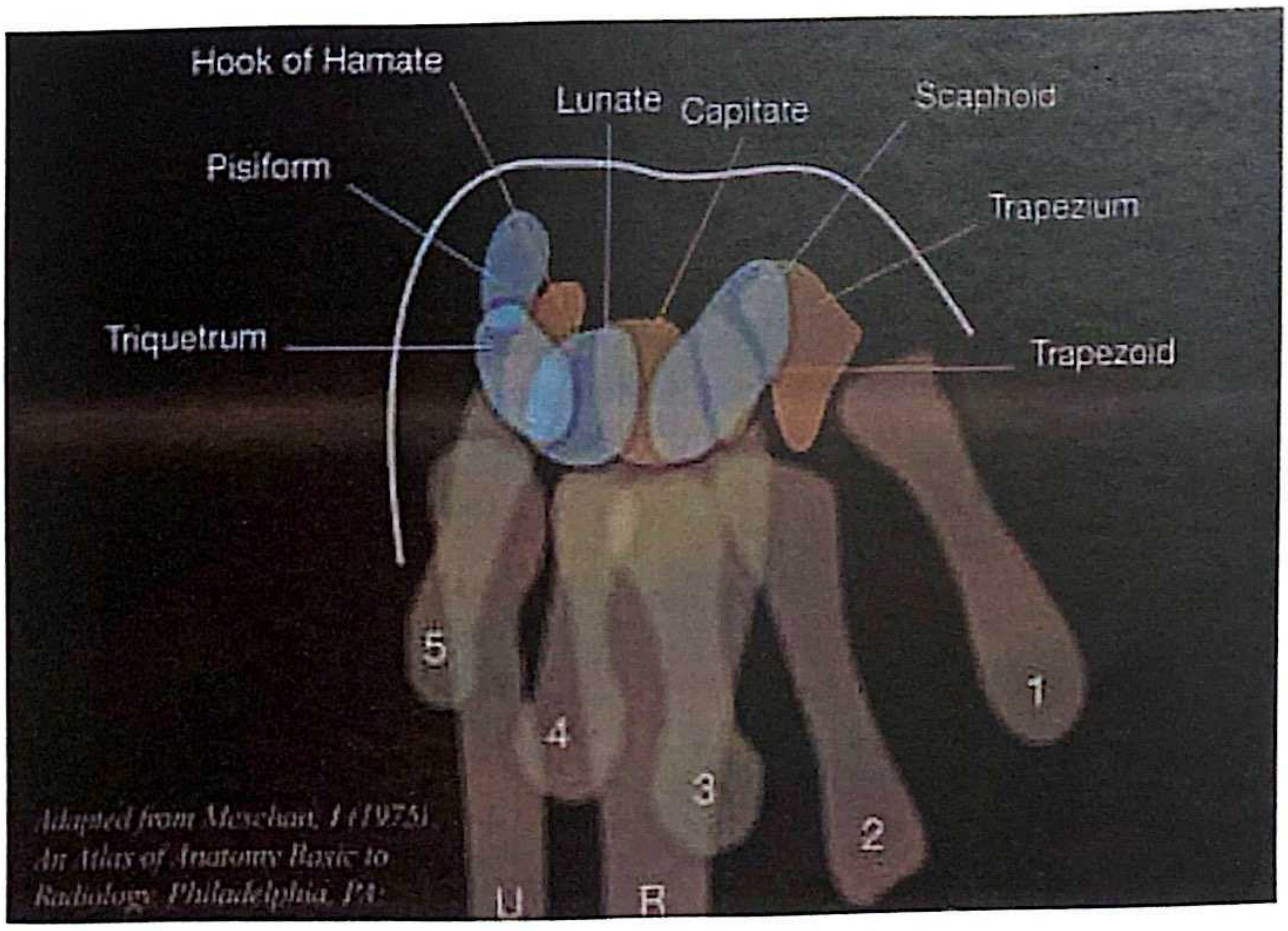
Centring:

1. Mid carpal region
2. The central ray is vertical and will be centred to the midpoint of the dorsiflexed wrist



Trapezium	scaphoid
Capitate	Hook of hamate
Pisiform	triquetrum

Try Playing Hard Car Sexaphone Trap


Hook of Hamate
Lunate
Capitate
Scaphoid
Pisiform
Trapezium
Triquetrum
Trapezoid
5
4
3
2
1
U
R

Adapted from Meschan, I (1975). An Atlas of Anatomy Basic to Radiology. Philadelphia, PA:

T_2 = fluid bright,
fat dark,

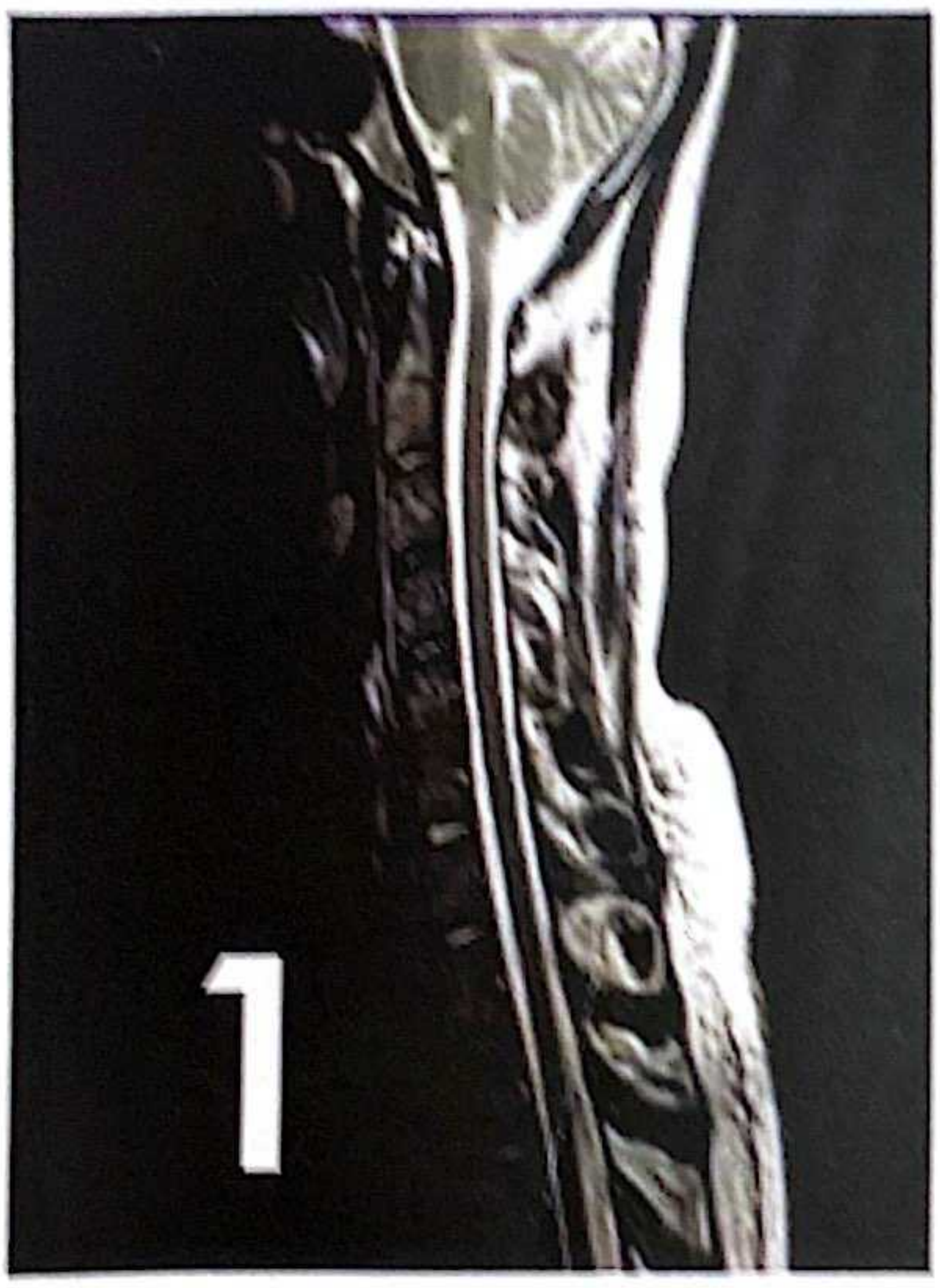
T_1 = fluid dark

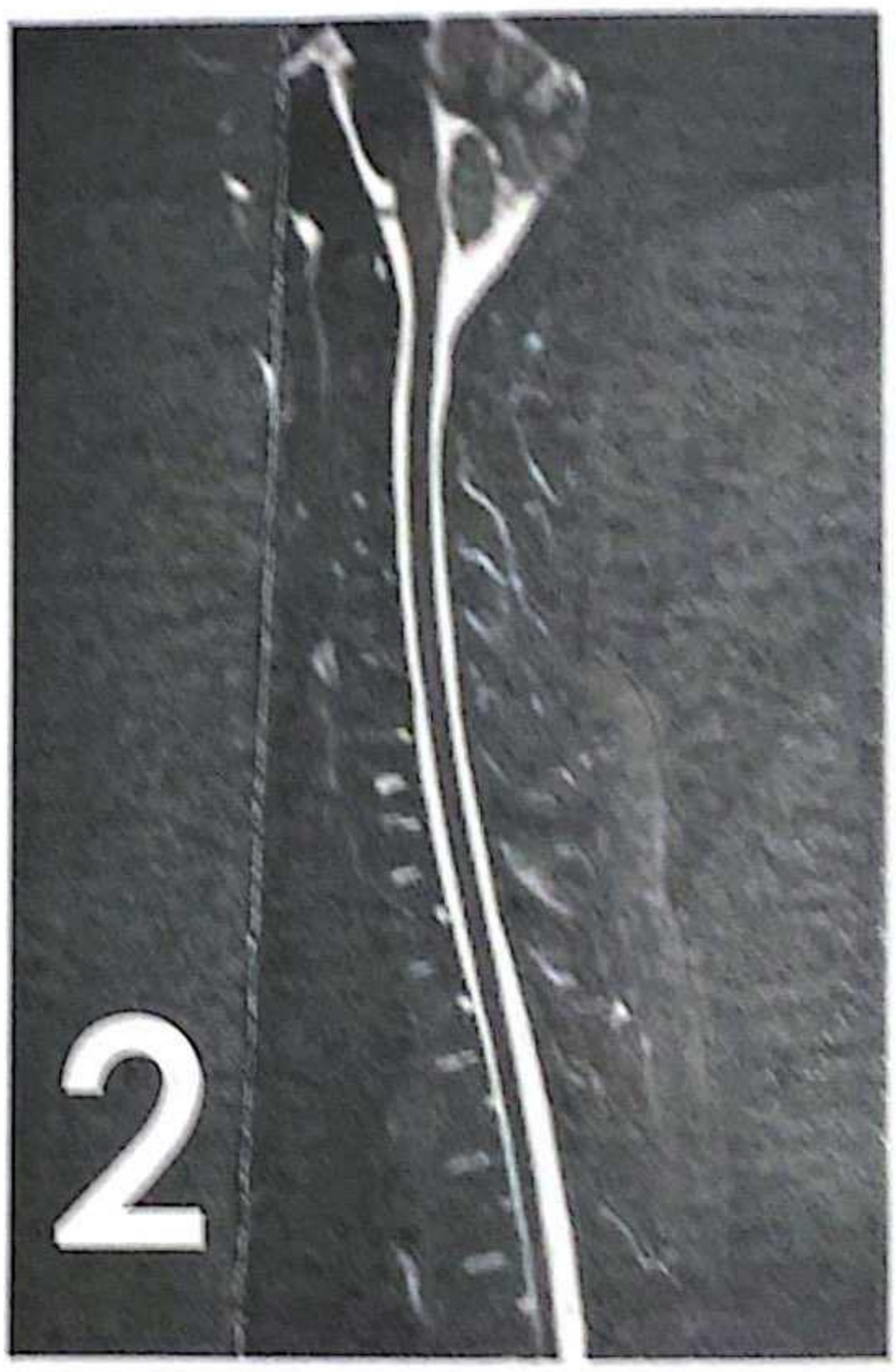
SEQUENCES

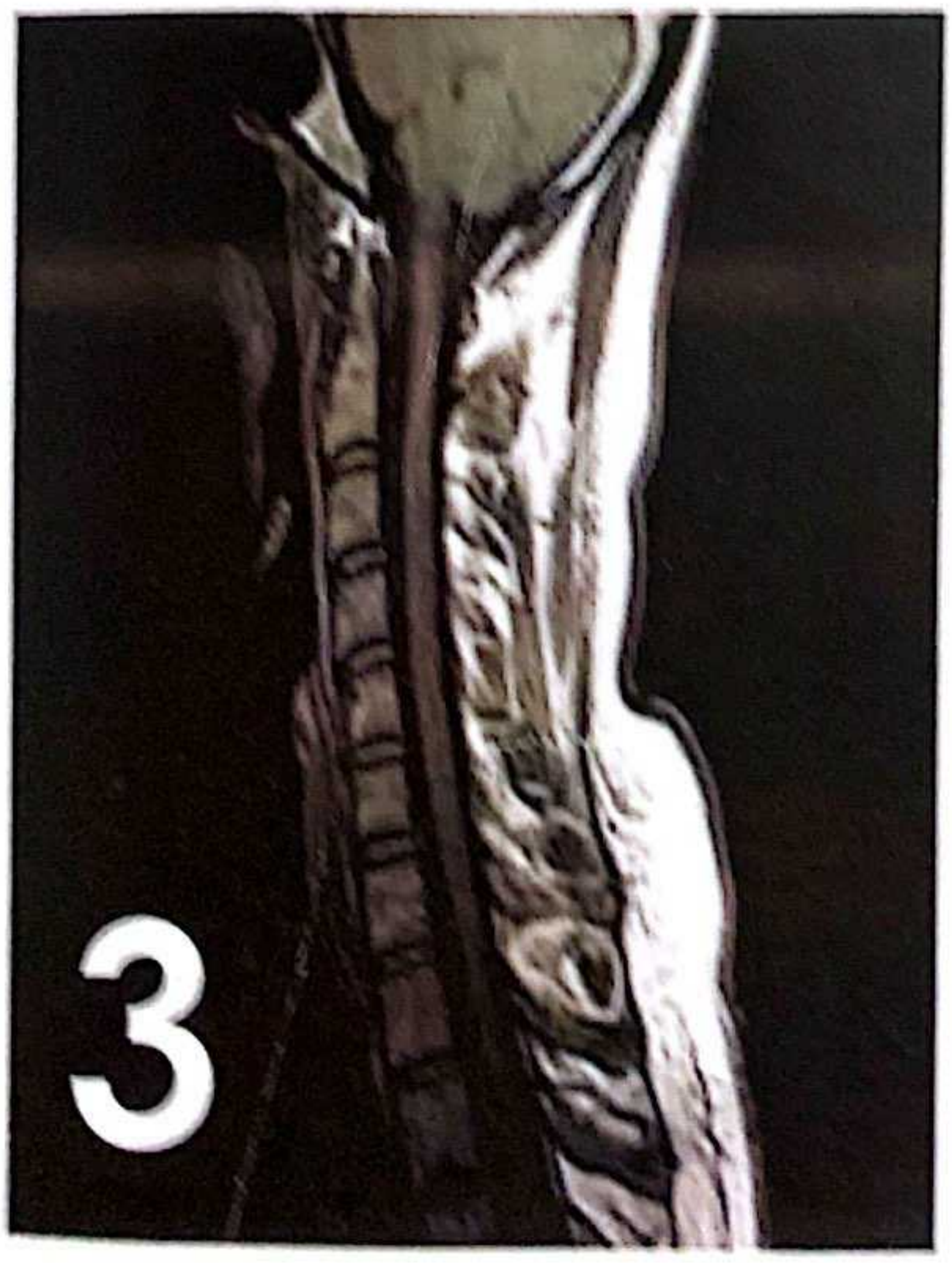
Fluid seen bright in fluid areas=T2
Fat seen dark on fat areas= T2 fat suppression
Fluid seen dark in fluid areas=T1

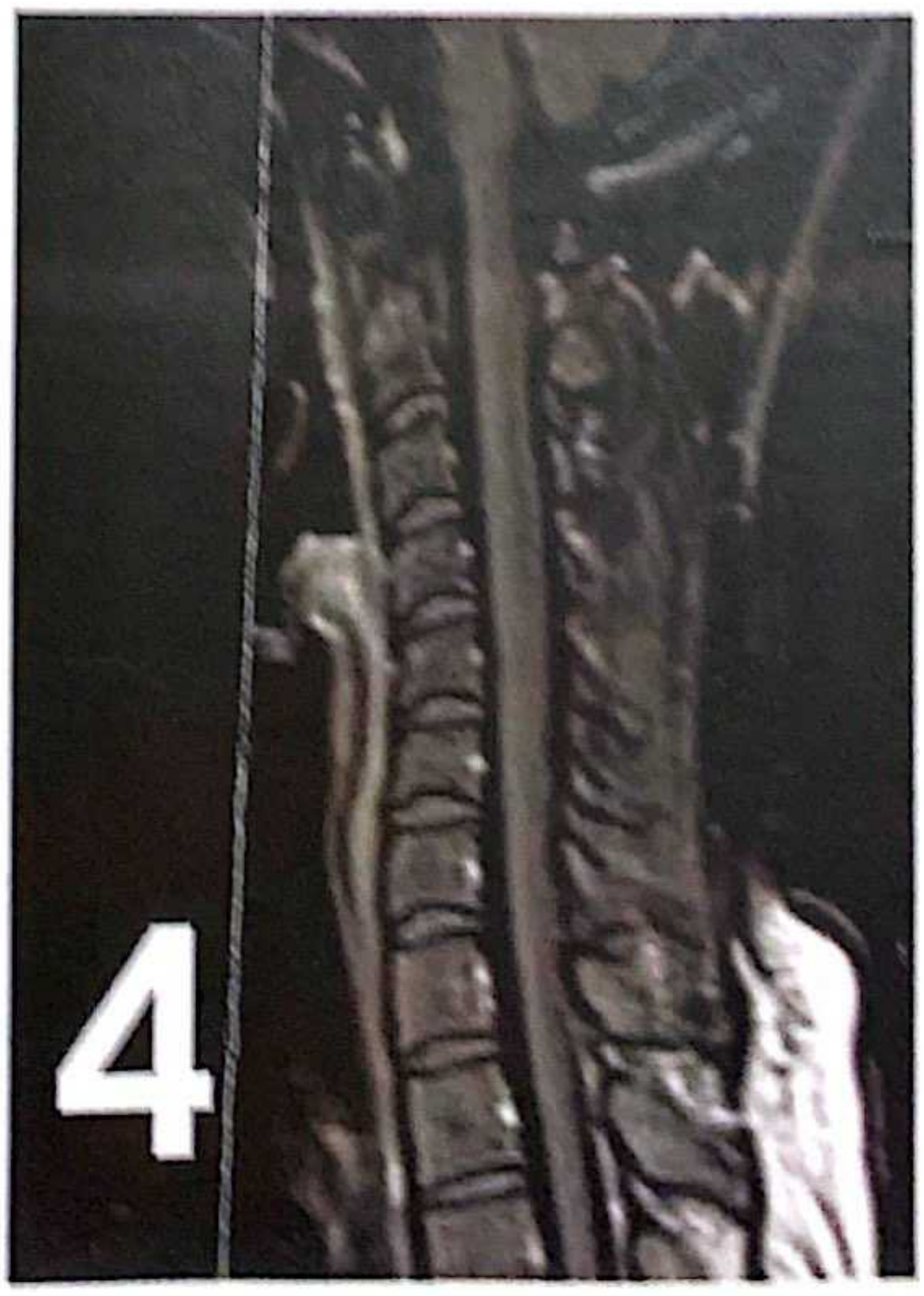
Q.1) Name the sequences **(2017)**

1. Sagittal T2 sequence of MRI cervical spine
2. Sagittal T2 FAT SAT/STIR sequence of MRI cervical spine
3. Sagittal T1 noncontrast sequence of MRI cervical spine
4. Sagittal T1 postcontrast FAT SAT sequence of MRI cervical spine

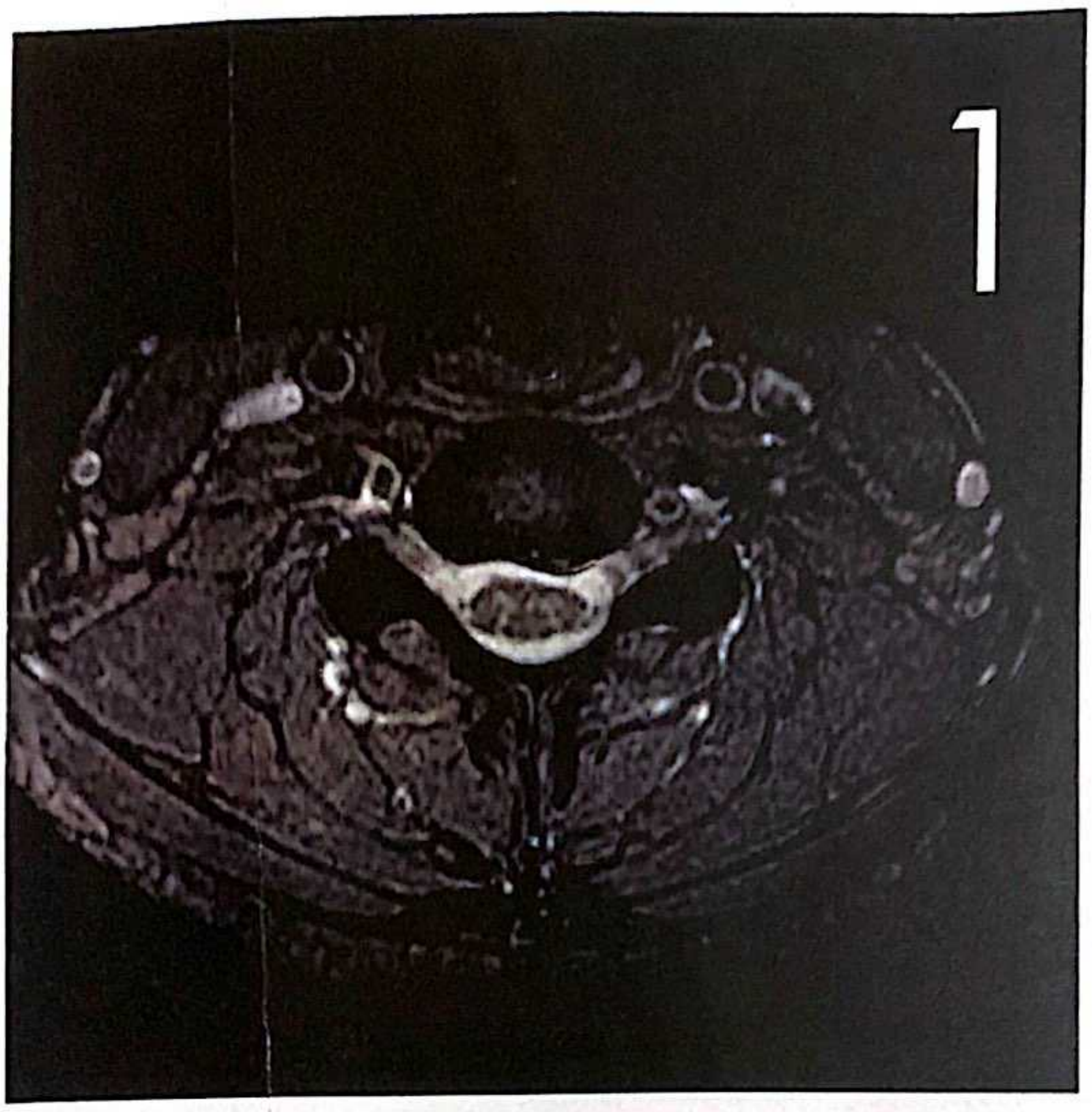


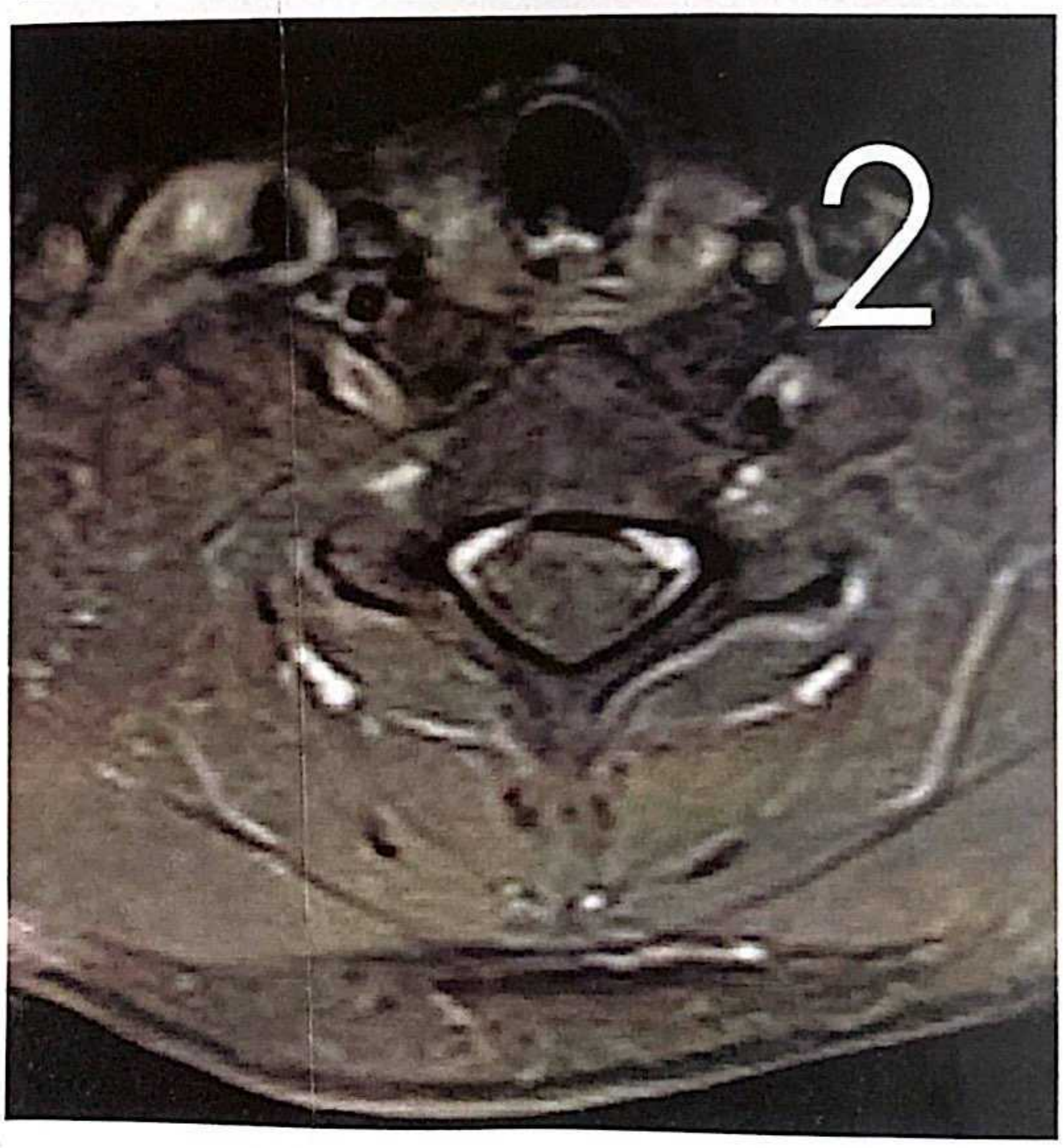






Q.2) Name the sequences (2016)





1. Axial T2 sequence of MRI cervical spine
2. Axial T1 post contrast FAT SAT sequence of MRI cervical spine

PROTOCOLS

Liver protocol (MRI)

Examination of the liver with MRI requires numerous sequences and imaging at multiple times after the administration of gadolinium. Many variations exist, but a typical protocol would include:

PRE-CONTRAST

T2

T2 fat sat

T1 weighted gradient echo in and out of phase

T1 2D or 3D gradient echo equences (e.g. VIBE)

POST-CONTRAST

T1 2D or 3D gradient echo equences (e.g. VIBE) at

arterial phase: 20-25 seconds

portal venous phase: 60-70 seconds

equilibrium phase: 3-5 minutes

hepatobiliary delayed phase: 10-30 minutes with and without fat sat

later delayed phase: 1 hour +/- 3 hours in some institutions

Magnetic Resonance Cholangiopancreatography

Magnetic resonance cholangiopancreatography (MRCP) is a non-invasive imaging technique to visualize intra and extrahepatic biliary tree and pancreatic ductal system.

It can provide the diagnostic range equivalent to the ERCP and so it can replace the ERCP in high risk patient to avoid significant morbidity.

Indications

MRCP can be used to evaluate various conditions of pancreatobiliary ductal system, some of them are:

identification of congenital anomalies of the cystic and hepatic ducts
post-surgical biliary anatomy and complications
pancreas divisum
anomalous pancreaticobiliary junction
choledocholithiasis
biliary strictures
chronic pancreatitis
pancreatic cystic lesions
trauma to biliary system

Physics

The technique exploits the fluid which is present in the biliary and pancreatic ducts as a contrast agent by acquiring the images using heavily T2 weighted sequences. Since the fluid-filled structures in the abdomen have a long T2 relaxation time as compared to the surrounding soft tissue, these structures appear hyperintense than the surrounding on a heavily T2 weighted sequence and can easily be distinguished.

Technique and protocols

No contrast is administered within the body.

Fasting for 4 hours prior to the examination is required to reduce gastroduodenal secretions, reduce motility to eliminate motion artifacts and to promote distension of gall bladder. MRCP is performed on a 1.5-T or superior MRI system, using a phased-array body coil.

All protocols obtain heavily T2 weighted sequences. Most commonly obtained sequences are:

RARE: rapid acquisition and relaxation enhancement
FRFSE: fast-recovery fast spin-echo coronal oblique 3D respiratory triggered

HASTE: half-Fourier acquisition single shot turbo spin echo- Axial 2D breath hold sequence which provide superior images and can be performed in single breath hold (<20 sec) and a fat suppressed sequence additional sequence which can be acquired to evaluate duct wall is fat suppressed T1 GRE sequence
For optimum visualization of ducts, acquired images are reformatted in different planes using multiplanar reconstruction (MPR) and maximum intensity projection (MIP).

The advantage of FRFSE, as a 3D technique, is the ability to perform multiplanar reconstructions. However, despite respiratory triggering, this sequence is often prone to motion artifact.

Technical modifications
With the evolution of MRCP, modified techniques came into existence. Commonly applied modified MRCP techniques are:

secretin stimulated MRCP
functional MRCP
negative oral contrast to 'null' the duodenum
commercially available agents
natural products such as pineapple juice which is rich in manganese and shortens T2 relaxation time
Practical points
Artifacts related to technique and reconstruction, motion or susceptibility artifacts due to metal clips and gas may give rise to poor spatial resolution as a result of that misinterpretation

Orbits protocol (MRI)

Sequences
A standard screening protocol might look like:

T1 weighted
plane: axial with FOV for the orbits and coronal (from chiasm through the orbits)
sequence: fast-spin echo (T1 FSE)
purpose: anatomical overview
T2 weighted (fat-saturated)
plane: axial
sequence: fat-saturated T2 FSE
purpose: highlight inflammatory changes
STIR / T2 weighted Dixon
plane: coronal (from chiasm through the orbits)
sequence: STIR or T2WI Dixon
purpose: highlight inflammatory changes
postcontrast sequences (fat-saturated)
plane: axial with FOV for the orbits and coronal (from chiasm through the orbits)
sequence: post-contrast fat-saturated fast-spin echo (T1 FSE).
Gadolinium-based contrast agents (GBCAs) for CNS 1:
gadoterate meglumine (Dotarem®)
gadobutrol (Gadavist®)
gadopentetate dimeglumine (Magnevist®)
gadobenate dimeglumine (MultiHance®)
gadodiamide (Omniscan®)
gadoversetamide (OptiMARK®)
gadoteridol (ProHance®)
all these GBCAs are approved by FDA at identical administered total doses of 0.1mmol/kg body weight 1
Purpose: given the relatively large amount of fat in the orbits, its suppression is essential when assessing abnormal enhancement in the characterization of tumours or inflammatory/infective change
Diffusion-Weighted Imaging (DWI)
plane: axial
sequence: DWI: B=0, B=1000 and ADC
purpose: multiple possible purposes (from the identification of ischemic stroke to the assessment of active demyelination)

Pituitary gland protocol (MRI)

Sequences

The sequences for this purpose should be performed with small FOV targeting the sella. A good protocol for this purpose involves at least:

T1

Sequence: small FOV coronal and sagittal

Purpose: useful for anatomical depiction, in particular, the posterior pituitary bright spot

T2

Sequence: usually coronal, but axial or sagittal can also be useful with high resolution/thin slices

Purpose: Identify blood product or dot sign in Rathke's cleft cysts

T1 C+ dynamic

Sequence: small FOV coronal, obtained at multiple locations through the pituitary gland (e.g. 6) at multiple times (e.g. 0, 30, 60, 90, 120 and 180 seconds)

Purpose: useful to identify microadenomas (which have delayed enhancement) and identify displaced normal pituitary gland by a sellar mass, and to help distinguish between residual or recurrent tumour from postoperative tissues 1

T1 C+ delayed

Sequence: small FOV coronal and sagittal (same as T1 non-contrast)

Purpose: valuable to assess the cavernous sinuses and to characterise other sellar region tumours

Some institutions also include some whole brain sequences (e.g. DWI/ADC and FLAIR).

Epilepsy protocol (MRI)

Sequences
Nonfocal epilepsy protocol
A good protocol for this purpose involves at least:

T1
sequence: axial and coronal; in modern scanners it can be replaced by a 3D isotropic acquisition
FLAIR

sequence: axial and angled coronal; in modern scanners it can be replaced by a 3D isotropic acquisition

inversion recovery sequences
DIR
sequence: 3D isotropic acquisition
DWI/ADC
SWI or T2*
Temporal lobe epilepsy protocol
A good protocol for this purpose involves at least:

T1
sequence: axial and coronal; in modern scanners it can be replaced by a 3D isotropic acquisition
FLAIR

sequence: axial and angled coronal; in modern scanners it can be replaced by a 3D isotropic acquisition

T2

sequence: angled coronal

DWI/ADC
SWI or T2*

Non-enhanced CT (NECT)
Helpful in detecting calcifications, fat in tumors, fat-stranding as seen in inflammation like appendicitis, diverticulitis, omental infarction etc.

Early arterial phase - 15-20 sec p.i. or immediately after bolus tracking
This is the phase when the contrast is still in the arteries and has not enhanced the organs and other soft tissues.

Late arterial phase - 35-40 sec p.i. or 15-20 sec after bolus tracking. Sometimes also called "arterial phase" or "early venous portal phase", because some enhancement of the portal vein can be seen. All structures that get their blood supply from the arteries will show optimal enhancement.

Hepatic or late portal phase - 70-80 sec p.i. or 50-60 sec after bolus tracking. Although hepatic phase is the most accurate term, most people use the term "late portal phase". In this phase the liver parenchyma enhances through blood supply by the portal vein and you should see already some enhancement of the hepatic veins.

Nephrogenic phase - 100 sec p.i. or 80 sec after bolus tracking. This is when all of the renal parenchyma including the medulla enhances. Only in this phase you will be able to detect small renal cell carcinomas.

Delayed phase - 6-10 minutes p.i. or 6-10 minutes after bolus tracking. Sometimes called "wash out phase" or "equilibrium phase". There is wash out of contrast in all abdominal structures except for fibrotic tissue, because fibrotic tissue has a poor late wash out and will become relatively dense compared to normal tissue. This is comparable to late enhancement of infarcted scar tissue in cardiac MRI.